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MAP FOLIO NO. 2

ONTARIO ARCTIC WATERSHED

C.L.A. Hutton
and
W.A. Black

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Preface

This paper is concerned with one of the most characteristic of Canadian landscapes; the region of the northern boreal forest, and specifically, the Ontario arctic watershed. The region is marked by serious socio-economic disparities that arise from the physical limitations imposed by climate and by the physiographical base of the region. The physical factors have contributed to the paucity of agricultural soils, to the extensive areas of muskeg and poorly drained land, to the fragmented forest stands and to the sparse distribution and localization of population.

The planning and management of our resources are of major concern to governments, to industry and particularly to the people who depend on them for a livelihood. That the aboriginal people are the most likely to be directly affected by resource developments in the north has been borne out by recent events in the Mackenzie Valley, the Peace-Athabasca delta region and James Bay, for example. The use of renewable and non-renewable resources is of primary interest to the Department of the Environment and to the Lands Directorate in particular. This study presents an overview of the resource situation in the Ontario arctic watershed; it should be of value to those who are concerned with fragile landscapes, with the development of the resource potential and with the welfare of the population.

Messrs. Hutton and Black have produced a study that should arouse interest and stimulate the preparation of more definitive studies in this region.

R.J. McCormack
Director General
Lands Directorate

Préface

Le présent document traite de l'un des paysages les plus caractéristiques du Canada: la région de la forêt boréale du Nord, et plus spécialement le bassin arctique de l'Ontario. La région souffre de graves disparités socio-économiques qui découlent des limites physiques dues au climat et à la base physiographique de la région. Les éléments physiques ont contribué à la rareté des sols agricoles, aux vastes étendues de muskeg et de terres mal drainées, aux peuplements fragmentaires des forêts, à la distribution éparse et à l'emplacement de la population.

La planification et l'exploitation de nos ressources intéressent spécialement les gouvernements, le monde industriel et aussi les gens qui dépendent de ces moyens de subsistance. Le fait que la population autochtone puisse être directement perturbée par l'exploitation des ressources dans le Nord s'est trouvé confirmé par les événements récents dans la vallée du Mackenzie, la région du delta Paix-Athabasca et la baie James, pour ne citer que des exemples. L'utilisation des ressources renouvelables et non renouvelables est un sujet d'intérêt primordial pour le ministère de l'Environnement et spécialement la Direction générale des terres. La présente étude constitue un exposé général de l'état des ressources dans le bassin hydrographique de la région arctique de l'Ontario; elle s'adresse à ceux qui s'intéressent aux paysages fragiles, à l'exploitation des ressources naturelles et au bien-être de la population.

MM. Hutton et Black ont rédigé une étude qui devrait éveiller l'intérêt et stimuler l'élaboration d'études plus poussées dans cette région.

R.J. McCormack
Directeur général
Direction général des terres

Acknowledgements

Data, which were compiled for tables and maps in the report, originated from numerous agencies of federal, provincial and municipal governments and from industries operating in the region. The tables on Indian activities and income were compiled from information provided by northern Indian agents of the Department of Indian and Northern Affairs (formerly the Department of Indian Affairs and Northern Development), Ottawa. Although the data provide a basis solely for estimates, they represented the best information then available. The maps are published at a scale of 1:4,750,000 or about 75 miles to the inch—a reduction to between one-fifth and one-sixth of the size of the original maps, which were compiled at a scale of 1:2,000,000. Consequently, much information has been compressed into small space; symbols and print appear in small size.

We are grateful to sources on the map sheets; to staff associates D.M. Gierman, E.A. Lacoste, E.N. Ward, M. Botten and D. Laurin, who assisted in the compilation of the maps; and to the Surveys and Mapping Branch, Department of Energy, Mines and Resources, for printing the maps. The cartography is primarily the work of the Cartographic Unit attached to the Lands Directorate. We thank all those who contributed photographs included in this study.

Abstract

The Ontario arctic watershed is the setting for an account describing the essential characteristics of the environment, population and economic activity of northern Ontario. The watershed comprises the northern half of northern Ontario—the latter is generally defined as that part of Ontario lying north of 47° N latitude. The watershed is a small part of two great bio-physical regions that cover much of Canada: first, the forest belt known as the northern boreal forest (the taiga), and second, the geological complex known as the Canadian or Precambrian Shield.

In this overview of the bio-physical and socio-economic aspects of the sectoral economies, the contributions of Indian and non-Indian peoples and of industry are viewed as important considerations in the formulation of practical resource-use policies. The present stage of development in the Ontario arctic watershed is contrasted with the adjacent region of the Canadian Shield of northern Ontario – the differences between the two are visually portrayed in the accompanying maps.

The first section provides a summary of environmental characteristics of the physiographical base of the region, particularly its geology, surficial sediments, topography, drainage and climate.

Urban and rural population distributions are described in the second section, with emphasis on the Indian population. Selected socio-economic characteristics of the Indian and non-Indian population are outlined.

The third section deals with resources and economic activity, including the mining industry, forest industries, agriculture, fur trapping, commercial fishing, recreation and tourism, electric power generation, transportation and communications.

Résumé

On a choisi le bassin hydrographique arctique de l'Ontario pour décrire les principales caractéristiques du milieu, de la population et de l'activité économique du nord de cette province, au-delà du 47° de latitude nord. Ce bassin hydrographique, qui comprend la moitié la plus au nord du nord de l'Ontario, appartient à deux grandes régions biophysiques qui couvrent la plus grande partie du Canada: premièrement, la ceinture forestière ou forêt boréale (la taïga) et deuxièmement, la formation géologique qu'on appelle le Bouclier canadien.

Dans cet aperçu des aspects biophysiques et socio-économiques des économies de secteur, on considère les apports des peuples amérindiens et non-amérindiens et de l'industrie comme des questions importantes dans la formulation de politiques pratiques sur l'utilisation des ressources. C'est pourquoi on a comparé le stade actuel de développement du bassin hydrographique arctique de l'Ontario à celui de la région adjacente, le Bouclier canadien du nord de l'Ontario, et les différences sont très visibles dans les cartes annexées.

La première partie donne un aperçu des caractéristiques environnementales de la base géophysique de la région, plus précisément en ce qui concerne la géologie, les sédiments superficiels, la topographie, le drainage et le climat.

La deuxième partie décrit les distributions démographiques urbaines et rurales et met l'accent sur les populations amérindiennes. On décrit certaines caractéristiques socio-économiques des populations amérindiennes et non-amérindiennes.

La troisième partie porte sur les ressources et l'activité économique dont l'industrie minière, les industries forestières, l'agriculture, le piégeage des animaux à fourrure, la pêche commerciale, les loisirs et le tourisme, la production d'électricité, le transport et les communications.

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Maps

Introduction

Maps form the core around which the resource theme of this paper is developed; the text is provided mainly to supplement and to explain patterns displayed on the maps. Data for the maps were originally collected during 1968 for a non-published paper. Consequently, the patterns of resource development are those of the late 1960's; the socio-economic characteristics of the population are based on 1961 census data, the most recent then available. The information concludes with 1968.

Since that time, many changes have occurred. Notably, Polar Bear Park has been substantially relocated and the number and location of operating mines has changed. Other changes have taken place in recent years: there has been a marked rise in the free-market price of gold and in the demand for furs; the demand for forest products has continued strong; and the "energy crises" has brought a renewed interest in the lignite deposits for thermal power generation. Substantial resource development is likely to have a profound effect on the people and the industries of the region. This study, therefore, provides a survey of the socio-economic situation in resource development before the onset of changes that were initiated in the early 1970's.

The five river basins, the Moose, Albany, Attawapiskat, Winisk and Severn, together with small streams flowing directly into James and Hudson bays, constitute the area covered by this report. They also constitute the "Ontario arctic watershed," a term which is used interchangeably with "study area" or with "study region." The term "northern Ontario," as defined by the provincial government, refers to that portion of the province north of 47° north latitude; it corresponds closely with the area shown on the maps.

Examination of the maps reveals that parts of the areas assigned to specific river basins are not directly associated with those basins. Between the five main basins, there are coastal areas where rivers and streams drain directly into Hudson and James bays rather than into any of the five main river systems. These "gaps" are attached to neighbouring basins according to a system of numbering adopted by the Water Management Service, Department of the Environment. The largest of these, located between the Winisk and Attawapiskat basins and consisting of the Ekwan system together with numerous other coastal streams, is included in the Winisk system. Thus, the Winisk basin shown on the maps is considerably larger than the Winisk basin proper and statistics relating to it have been inflated accordingly. The other basins are similarly affected by the inclusion of small coastal streams, but to a much lesser degree.

The work upon which this paper is based was initiated in 1968 in the former Economic Geography Section, then in the Policy and Planning Branch of the Department of Energy, Mines and Resources, for purposes of providing background information in a federal-provincial study of environmental resources in the Ontario arctic watershed. The original name of the paper was "Northern Ontario Resources" as indicated on the maps. When, late in 1971, most of the Economic Geography Section was transferred to the newly established Lands Directorate, Department of the Environment, the Lands Directorate subsequently undertook to publish a summary, as a contribution to general knowledge of resource patterns, and the paper was renamed the "Ontario Arctic Watershed."

THE PHYSICAL ENVIRONMENT

Geology and physiography

The Ontario arctic watershed study extends over substantial portions of two major physiographic regions, the Hudson Bay Lowland and the Canadian Shield. Within the Shield a physiographic subregion, known as the Clay Belt, is of particular significance because it contains most of the population. The main geological and physiographic characteristics are indicated on Map 2 and on Map 3, Surficial Geology.

Hudson Bay Lowland

The Hudson Bay Lowland is a flat, poorly drained plain occupying about one-quarter of the Province of Ontario and about one-half of the study area. Maximum elevation is about 500 feet at the Lowland-Shield contact in the Albany River basin.

Bedrock is composed mainly of limestones and shales deposited during the Ordovician and Silurian periods of the Palaeozoic era. These sedimentary formations occupy a basin in the Canadian Shield; their total thickness is greatest at the centre of the basin now occupied by Hudson Bay and least at the Lowland-Shield contact. Under relatively level topography, the bedrock dips gently toward Hudson Bay at about 3 or 4 feet per mile. Outcrops of the sedimentary bedrock are few; they occur mainly in the Shield-Lowland contact zone and in deeply eroded river channels.

The surficial materials of the Lowland, which originated at the end of the Pleistocene glacial era, are shown on Map 3, Surficial Geology. Recessional features, such as moraines, eskers and kames, are responsible for much of the local relief and most of the region's well-drained land, particularly in the Moose basin area. Much of the surface is covered by marine clay deposited at the time of the Tyrell Sea, a larger prototype of Hudson Bay. The whole area, mantled with marine deposits, tends to be poorly drained, so that extensive peat bogs, capped by muskeg, have developed. String bogs and quaking bogs are gradually filling in many lakes and ponds.

Perennially frozen ground or permafrost occurs throughout much of the study area–Map 3, Bog and Permafrost (Brown, 1968).* A zone of continuous permafrost occupies a narrow band along the southern shore of Hudson Bay. Inland from this narrow band, a wide zone of discontinuous permafrost occurs, which becomes increasingly thin and interrupted toward the south. In this zone, permafrost areas are limited to peat bogs which, in the Lowland, correspond generally to the areas of marine clays.

Four main factors contribute to the poorly drained nature of the Lowland (Map 1). First, the drainage pattern was thoroughly deranged during glaciation, and since deglaciation, there has been insufficient time for the re-integration of the drainage network. Second, the frost-free period is short–from 3 to 4 months–and allows little time for rivers to develop their channels. Third, integration is inhibited by the widespread occurrence of permafrost. Fourth, stream gradients in the Lowland are gentle, and as there are few abrupt changes in gradient, stream flow tends to be sluggish. During glaciation, the Lowland area was depressed by the weight of the ice cap. At present, crustal or isostatic rebound is taking place (Lee, 1968). Parallel to the Hudson Bay coast, a zone 5 to 30 miles wide has developed which is characterized by marine features such as bars, beaches, and extensive tidal flats. At the coast, these features are still forming, whereas inland they are static, remnants of former relatively high sea levels. The bars and beaches are well drained and are much less susceptible to permafrost than are the bogs.

The rivers of the Lowland are marked by long straight reaches. The channels occupy broad river troughs that are being widened and deepened in many parts by the abrasive action of drifting ice and spring flood waters.

The main rivers thread through deltas or expand into broad shallow estuaries before discharging into Hudson or James bays. In spring flood, water levels in the channels may reach 30 to 50 feet above July-August water levels. At low water these channels usually contain pools and stretches of trapped water, while the main channels are blocked by bars and shoals. At low tide the water may retreat from its high-water mark to expose 2 to 6 miles of

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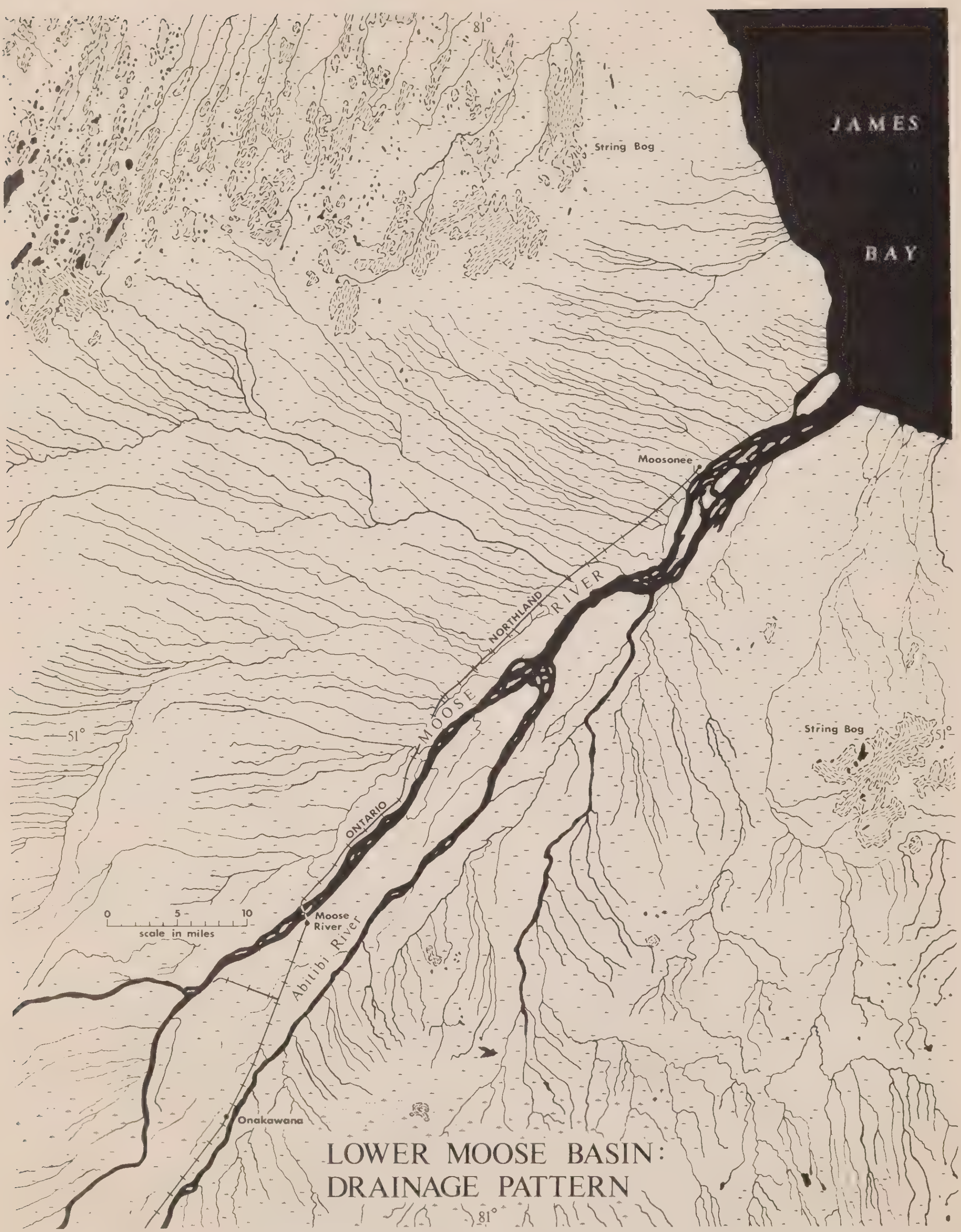
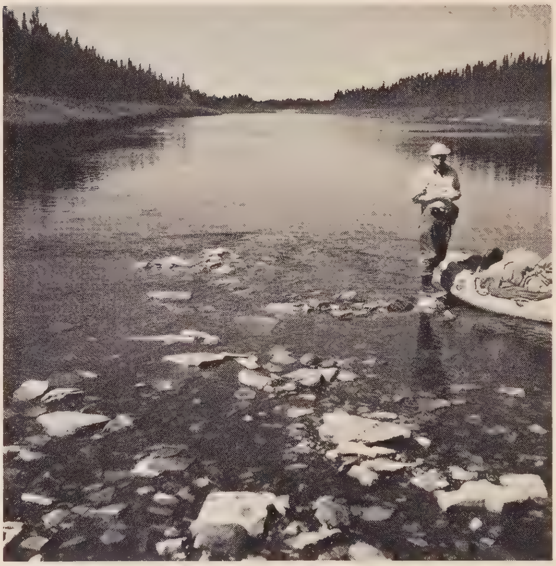
*Citations which are referred to specifically in the text (references) are marked with an asterisk in the list of sources in the Bibliography and References section.

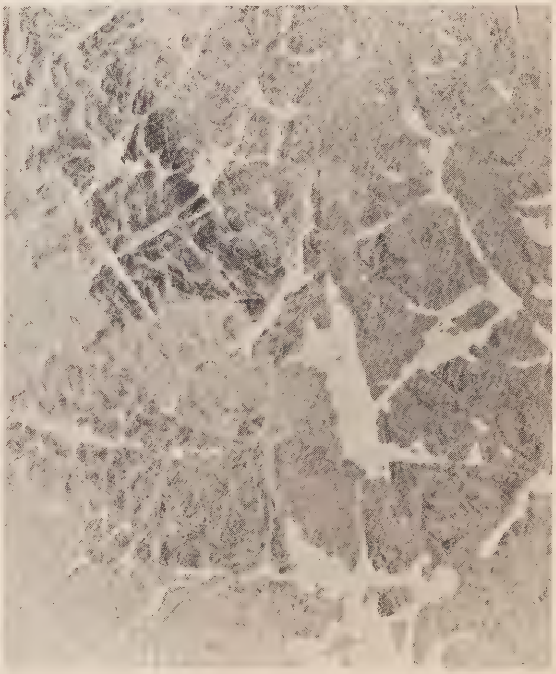
Map 1. Lower Moose basin drainage pattern



The passage of the Ekwan River over shallow limestone rocks gives rise to frequent rapids; the grass-covered banks are swept by high water in the spring.
Credit—Geological Survey of Canada

Glaciation in the western part of the Canadian Shield (near the Manitoba boundary) was intense. It has resulted in rough, rocky ridges paralleled by narrow lakes and depressions.





broad foreshore flats; whereas during high spring floods the water levels rise to within 5 to 10 feet of the top of river banks near the mouth. Tides and gales, particularly when they coincide, cause wide fluctuations in the depth of the water in the channels. High tides at Moose Factory are 6 to 7 feet, and at Churchill 14 to 17 feet, above mean sea level.

With the exception of some coal and gypsum deposits, few known mineral occurrences exist in the Lowlands (Whitmore and Liberty, 1968). Further explorations may yield economic oil and gas deposits in the northern and northwestern sections of the area. Economic quantities of lead and zinc, similar to those in the Pine Point area on the southern shore of Great Slave Lake, may exist in the sedimentary bedrock, while construction materials, such as sands and gravels are associated with kames, eskers and outwash deposits. As the major rivers have gentle gradients, few sites are suitable for hydroelectric power generation and there are comparatively few impediments to navigation except during low water.

Canadian Shield

The Canadian Shield, composed of ancient crystalline rocks, surrounds the Hudson Bay Lowland on all sides but the north. Some of these Precambrian rocks are among the oldest on earth, formed 2,390 million years B.P. (Before Present). From a distance, the Shield offers a flat horizon to the viewer. Locally, however, relief may be quite rugged—the result of differential erosion by water and by ice. The maximum elevation, somewhat over 1,500 feet, occurs in the southern part of the Moose River basin.

The rocks of the Shield are of igneous and metamorphic origins. Granitic and gneissic rocks are interspersed with metasedimentary and volcanic material in complex structures (Map 2). The metasedimentary volcanic belts are rich in ores which provide most of northern Ontario's mineral output.

Outcrops of bedrock are common in the Shield, since much of the overlying material was stripped away by glacial action. Recessional features such as end moraines and eskers, especially in the southern and western parts of the region, add to surficial variety; extensive areas of the Shield

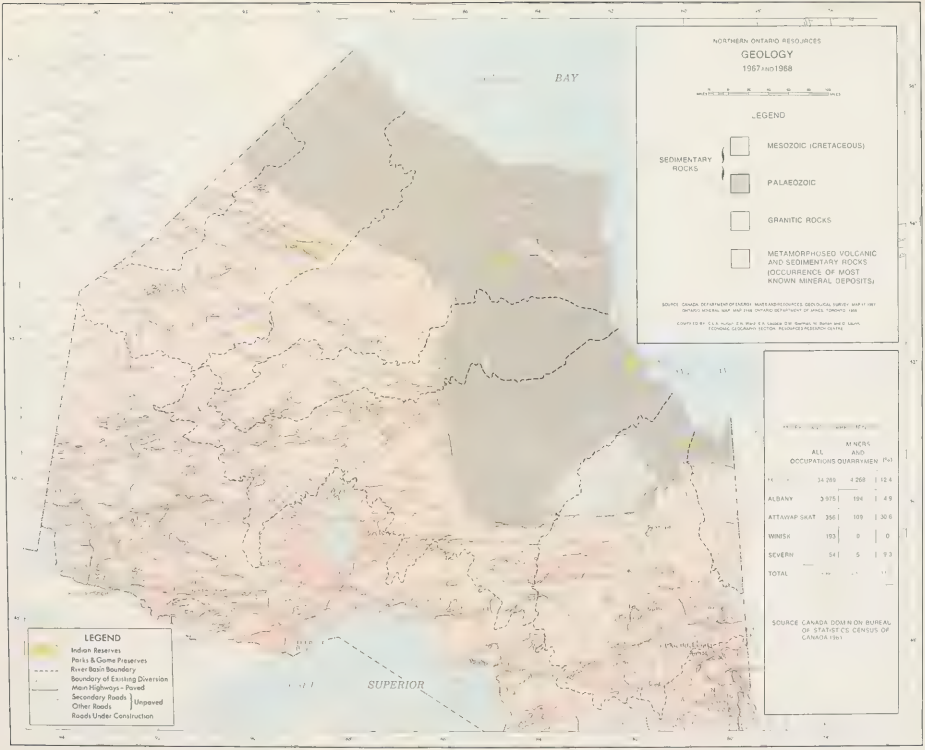
are covered in varying degrees with lacustrine sediments and ground moraine (Map 3, Surficial Geology).

Discontinuous permafrost is found in parts of the Shield lying north of approximately 52 degrees latitude—a line which roughly coincides with the annual 30°F isotherm. As in much of the Hudson Bay Lowland, permafrost is confined to bog areas, which, in turn, are much restricted by extensive rock outcrop.

As in the Lowland, the drainage pattern was deranged by glacial action during the Pleistocene, and in the short time since deglaciation the hard bedrock has resisted stream-channel development. Thus the stream courses in the Shield have irregular gradients with chains of lakes joined by short, turbulent river links, and wherever the river plunges over rock outcrops, there are chutes, rapids or falls. Topographic variability has provided many sites with hydro-power potential, much of which has been developed, particularly in the Moose basin.

Clay Belt

The Clay Belt is a physiographic subprovince which lies within the Canadian Shield and which trends east-west across the centre of Moose basin. The land surface is composed of lacustrine clays deposited in glacial Lake Barlow-Ojibway as a veneer over older ground moraine. Although the clay veneer has tended to subdue the topography to some extent, there are widespread shallow depressions in which peat bogs have developed. For agricultural purposes, drainage in the Clay Belt is generally poor. Although an estimated 16 million acres are considered to have agricultural potential, only some 75,000 acres were improved farmland in 1968 (see footnote, Agriculture section).



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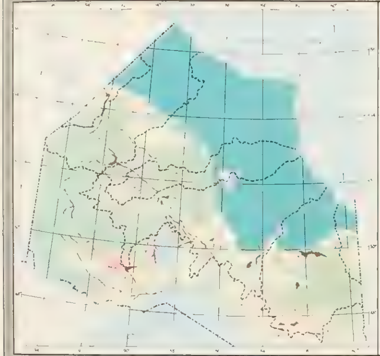


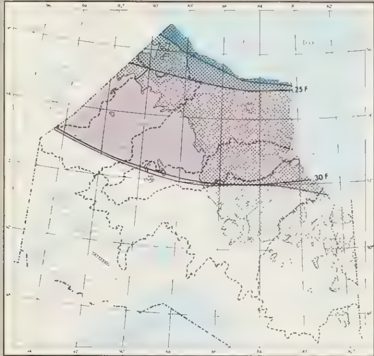
NORTHERN ONTARIO RESOURCES

SURFICIAL GEOLOGY

- OUTWASH AREA
- ESKER, KAME, KAME-COMPLEX
- END MORAINE
- LACUSTRINE SEDIMENTS
- MARINE SEDIMENTS
- GROUND MORAINE

SOURCE

CANADA DEPARTMENT OF ENERGY MINES AND RESOURCES GEOLOGICAL SURVEY GLACIAL MAP OF CANADA 1253A



NORTHERN ONTARIO RESOURCES

BOG AND PERMAFROST

- CONTINUOUS PERMAFROST
- DISCONTINUOUS PERMAFROST
- SCATTERED PATCHES OF PERMAFROST
- BOG

SOURCES

BROWN R.J.E. PERMAFROST INVESTIGATION IN NORTHERN ONTARIO AND NORTHEASTERN MANITOBA, 1968. "PERMAFROST IN CANADA" MAP 1246A GEOLOGICAL SURVEY OF CANADA WITH NATIONAL RESEARCH COUNCIL OF CANADA 1967 MAP "OUTCROP AND DRIFT COVER" J. FALCONER 1958 PUBLISHED ON GLACIAL MAP OF CANADA

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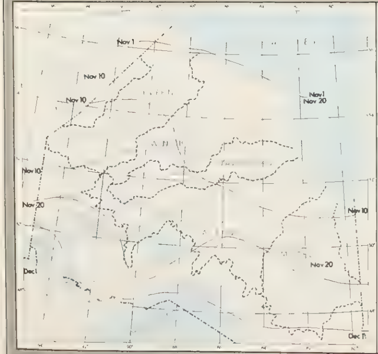

NORTHERN ONTARIO RESOURCES

MEAN DATES OF THE FREEZE-OVER OF RIVERS, LAKES AND BAYS

- NOV. 10, RIVERS
- NOV. 10, LAKES AND BAYS

SOURCES

CANADA DEPARTMENT OF TRANSPORT METEOROLOGICAL BRANCH TECHNICAL CIRCULAR NO 4116 1964 THE BREAK-UP AND FREEZE UP DATES IN CANADA

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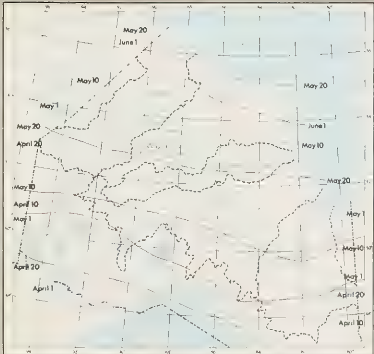

NORTHERN ONTARIO RESOURCES

MEAN DATES OF THE BREAK-UP OF ICE IN RIVERS, LAKES AND BAYS

- MAY 10, RIVERS
- MAY 10, LAKES AND BAYS

SOURCES

CANADA DEPARTMENT OF TRANSPORT METEOROLOGICAL BRANCH TECHNICAL CIRCULAR NO 4116 1964 THE BREAK UP AND FREEZE-UP DATES IN CANADA

COMPILED BY

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Climate

Weather and Precipitation

The climate of northern Ontario has been classified as modified continental: Lake Superior and Hudson Bay are primarily responsible for the modification (Chapman and Thomas, 1968). In winter, dry cold arctic air covers the region; precipitation results primarily from incursions of warmer air from the south. Summer weather is much more variable; frontal interaction by converging air masses produces frequent temperature changes and periods of rainfall. In summer, five types of air masses interact across northern Ontario: air from the Pacific Coast lies over the area from 20 per cent of the time in the east to 40 per cent in the west; air from the south is present from 30 to 40 per cent of the time, continental arctic air, from 10 to 30 per cent; air from Hudson Bay from 5 to 8 per cent; and air from the Atlantic Coast occurs only occasionally (Bryson, 1966). The interaction of these air masses produces considerable variability in the regional weather patterns. Generally, in winter, the arctic frontal zone lies to the south of the region; whereas the summer position skirts the northern limits of the Ontario arctic watershed. These boundaries tend to demarcate the northern boreal forest (Bryson, 1966).

Hudson Bay and Lake Superior contribute further climatic variations (Chapman and Thomas, 1968). During summer, their effect is to moderate temperatures, but these effects are diminished during winter when their surfaces are ice covered. Latitudinal effects are apparent in the general south-to-north decrease in temperature. Topographic variability also contributes to climatic variability. Throughout the region in winter, cold dense air from the higher areas tends to drain into the valleys, creating cold air sinks. In addition, high elevation at the eastern end of Lake Superior causes substantial orographic precipitation.

Summer temperatures are cool; winter temperatures are severe. Map 4, Mean Daily July Temperature, shows that the mean temperature for July ranges from 54°F along the Hudson Bay coast to about 63°F in the extreme southeast area of the Moose basin. January temperatures follow a similar regional pattern: mean temperatures range from $^{-}12$°F in the lower Severn and Winisk basins to 4°–6°F in the extreme southeast area of the Moose basin (Map 4, Mean Daily January Temperature).

Total mean annual precipitation varies from 20 inches in the northeast to over 36 inches in the highlands east of Lake Superior (Map 5, Mean Annual Precipitation). The annual average rainfall of 14 to 16 inches, which occurs from May through September, is remarkably consistent in distribution throughout the area and throughout the growing season. From October through April, most of the precipitation falls as snow, which varies from a total of 64 inches in the west to a maximum of 143 inches at Helen Mines in the highlands east of Lake Superior.

Patterns of the mean maximum snow depth, which include allowance for melting and compaction, are shown on Map 5, Mean Maximum Snow Depth. The prevailing snow depth varies from 25 inches in the upper Severn to 35 inches in the Moose basin. The mean maximum water equivalent of snow for each of the five major river basins in the Ontario arctic watershed is estimated as follows: Moose, 8-10 inches; Albany and Attawapiskat, 6-8 inches each; Winisk, 5-7 inches; and Severn, 5-6 inches (Map 5, Mean Maximum Water Equivalent of Snow).

Freeze-up and Break-up

Mean annual dates of freeze-up and break-up of rivers, lakes, and bays vary widely throughout the region (Map 3, Mean Dates of the Freeze-over of Rivers, Lakes and Bays). According to available data, rivers freeze 10 to 20 days later than other water bodies, while northern lakes and bays in a zone parallel to the Hudson Bay coast are usually frozen over on about November 1. Freeze-up progresses to the southernmost parts of the study area by December 1. The pattern of progression for rivers is somewhat different: those in the northwest part of the study area along the Manitoba border freeze earliest—by November 10. Freeze-up progresses southeastward until about December 20 by which time most rivers are frozen over. A downstream variation in freeze-up in the regional pattern occurs: the interval between the freeze-up of river mouths and that of headwaters may be several weeks, although the average lapse of time is about 10 days. The headwaters of the rivers flowing into James Bay freeze over from November 20 to December 1; whereas the headwaters of rivers flowing into Hudson Bay freeze over from November 10 to 20. Lakes

The lattice pattern of the muskeg is particularly marked; improved drainage gives rise to improved forest growth near the Attawapiskat River.

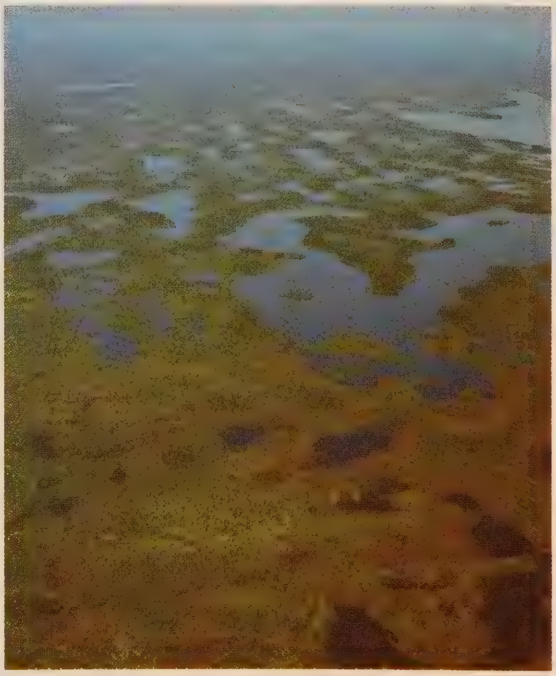
Residual ice piled on the banks during the spring break-up is characteristic of high water levels in the rivers of the Hudson Bay Lowland. This photograph shows the ice on the banks of the Harricanaw River.

View of the Hudson Bay Lowland in June.
Credit—Geological Survey of Canada

and slack water freeze over considerably earlier than rapids and fast water.

The dates of spring break-up have special significance, for they indicate the beginning of the period of maximum runoff (Map 3, Mean Dates of the Break-up of Ice in Rivers, Lakes and Bays). The process of break-up is generally opposite to that of the freeze-over sequence but somewhat more lengthy. Rivers break up first. In the southeast, for example, break-up progresses northward through the Moose system from April 10 to May 1, but the occurrence is delayed in the Severn until the period from April 20 to May 20. Lakes and bays in the southern Moose are ice-free on the average by April 20, and in the north, along Hudson Bay, by June 1. Fast water sections of rivers break up first, usually from one to several weeks before the lakes. In the lakes, the ice usually melts in situ.

The break-up of river ice shows a marked variation from the regional pattern. In the northward-flowing rivers, such as the Severn, Winisk and Moose, the break-up may take as long as several weeks to reach the mouths, and from 1 to 2 weeks on the eastward-flowing Albany and Attawapiskat rivers.



Stream Flow and Water Use

High-water levels, varying considerably from year to year, depend upon the occurrence of spring break-up, the accumulation of winter snowfall, prolonged spring rains, and upon the ability of the coniferous forest to retard runoff. Meltwater from the land combines with that from melted ice in rivers and lakes to produce peak runoffs. Since the floating ice drifts downstream as break-up progresses, frequent ice jams occur that block drainage, raise river levels 25 to 30 feet above ordinary water levels and produce flooding in upstream areas, particularly in the Lowlands.

The graphs "Seasonal Variations in Stream Flow," Map 6, show that stream flows in the Moose River tributaries peak in May. With one exception, the Abitibi River, all tributaries are marked by a sharp rise and an almost equally sharp fall. On the Abitibi, the high water peak is reduced in level but prolonged from April to early

July; the reservoir effect of Lake Abitibi tends to stabilize the flow.

Map 6 shows the increase in the volume of water as the rivers approach the coast. A comparison in the volume of water at the mouth of each river is given in Table 1.

TABLE 1. Volume of stream flow discharged into James and Hudson bays (in billions of gallons per day, Bgd)

River basin	Bgd	Bgd's as % of total
Severn	11.0	11.7
Winisk	9.6	10.3
Attawapiskat	9.7	10.3
Albany	31.8	34.1
Moose	31.4	33.6
Regional total	93.5	100.0

The Albany and Moose rivers account for two-thirds of the total discharge of the region. The Severn, Winisk and Attawapiskat each discharge only about one-third of the quantity carried by either the Albany or Moose rivers. Expressed in other terms, the rate of flow of either the Albany or Moose is somewhat greater than the combined rate of the Severn, Winisk and Attawapiskat rivers. Inset graphs in Map 6 indicate that by far the greatest use of water by man occurred in the Moose basin; a comparatively minor amount was used in the Albany. The other rivers of the Ontario arctic watershed are undeveloped.

Evapotranspiration

Evapotranspiration is a measure of the amount of water lost from the earth's surface and its vegetative cover through evaporation and transpiration. Potential evapotranspiration, or PET, indicates the amount of evaporation and transpiration that would occur if an unlimited quantity of moisture were available. Greatest PET tends to occur in the south where temperatures are highest, although during long summer daylight hours at higher latitudes, daily rates can approach those of more southerly areas. These factors are included in calculations which produced the patterns shown on Map 4, Potential Evapotranspiration.*

Rainfall, snowfall, and potential evapotranspiration data are combined to produce Map 5, Mean Annual Runoff.† The amount by which total annual precipitation exceeds PET, including a factor for soil moisture storage, indicates the quantity of water available for stream flow. Map 5, Annual Runoff, indicates variations of from 6 inches in the west to over 21 inches in the highlands east of Lake Superior. Greater snowfall in the east than in the west accounts for the pronounced westward bend of the 12-inch to 16-inch isolines of runoff. The orographic effect at the eastern end of Lake Superior explains the large amount of runoff in that area.

Generally, average annual precipitation exceeds evapotranspiration by as much as 16 inches in the eastern Moose basin, and by 9 inches in the northwest. This factor, together with poor physical drainage conditions, contributes to the propagation of the muskeg cover of the Lowland.

From the air, the muskeg presents a monotonous flatness, a glass-like slick of wet surfaces, variegated hues of greens and russets, an imperceptible blending of land and lake without shores—a remarkable adaptation of vegetation to climate and landform (Moon, 1970). The muskeg suggests a vast reservoir of shallow water that is interlaced by a lattice of sphagnum (the dominant plant species), sedge and heath vegetation; it is mainly a surface of standing water, of quaking bogs, string bogs, raised bogs, and of a soggy, waterlogged wetland.

*As this northern area is not included in Thornwaite's published tables (C.W. Thornwaite, Geogr. Rev. 38, pp. 55-94, 1948), calculations for Map 4, Potential Evapotranspiration, were prepared by D.M. Gierman.

†Map 5, Mean Annual Runoff, was prepared by the Inland Waters Branch, Department of Energy, Mines and Resources.

NORTHERN ONTARIO RESOURCES

MEAN DAILY JULY TEMPERATURE

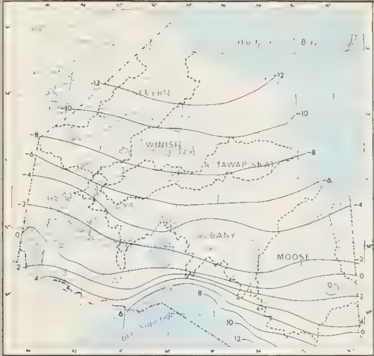
IN DEGREES F

SOURCE

CHAPMAN, L.J. AND THOMAS, M.K. THE CLIMATE OF NORTHERN ONTARIO. DEPARTMENT OF TRANSPORT, METEOROLOGICAL BRANCH, CLIMATOLOGICAL STUDIES, NO. 6, 1968

COMPILED BY

C.L.A. HUTTON, D.M. GIERMAN AND E.A. LACOSTE, ECONOMIC GEOGRAPHY SECTION, RESOURCES RESEARCH CENTRE



NORTHERN ONTARIO RESOURCES

MEAN DAILY JANUARY TEMPERATURE

IN DEGREES F

SOURCE

CHAPMAN, L.J. AND THOMAS, M.K. THE CLIMATE OF NORTHERN ONTARIO. DEPARTMENT OF TRANSPORT, METEOROLOGICAL BRANCH, CLIMATOLOGICAL STUDIES, NO. 6, 1968

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C.L.A. HUTTON, D.M. GIERMAN AND E.A. LACOSTE, ECONOMIC GEOGRAPHY SECTION, RESOURCES RESEARCH CENTRE

NORTHERN ONTARIO RESOURCES

MEAN ANNUAL FROST-FREE PERIOD

IN DAYS

SOURCE

CHAPMAN, L.J. AND THOMAS, M.K. THE CLIMATE OF NORTHERN ONTARIO. DEPARTMENT OF TRANSPORT, METEOROLOGICAL BRANCH, CLIMATOLOGICAL STUDIES, NO. 6, 1968

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C.L.A. HUTTON, D.M. GIERMAN AND E.A. LACOSTE, ECONOMIC GEOGRAPHY SECTION, RESOURCES RESEARCH CENTRE

NORTHERN ONTARIO RESOURCES

POTENTIAL EVAPOTRANSPIRATION

IN INCHES

SOURCES

CANADA DEPARTMENT OF TRANSPORT, METEOROLOGICAL BRANCH, CLIMATOLOGY DIVISION. "TEMPERATURE NORMALS FOR ONTARIO" – C.D.S. NO. 6, 1964. "TEMPERATURE NORMALS FOR MANITOBA" – C.D.S. NO. 2, 1965. "SUPPLEMENTARY TEMPERATURE NORMALS", C.D.S. NO. 13, 1965.
"STANDARD TIME AND TIME ZONES", C.C. SMITH AND M.M. THOMSON. THE JOURNAL OF THE ROYAL ASTRONOMICAL SOCIETY OF CANADA, VOL. 62, P.P. 193-223, OCTOBER 1968

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C.L.A. HUTTON, D.M. GIERMAN AND E.A. LACOSTE, ECONOMIC GEOGRAPHY SECTION, RESOURCES RESEARCH CENTRE

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NORTHERN ONTARIO RESOURCES

MEAN ANNUAL PRECIPITATION

IN INCHES

COMPILED BY

INLAND WATERS BRANCH DEPARTMENT OF ENERGY MINES AND RESOURCES

NORTHERN ONTARIO RESOURCES

MEAN MAXIMUM SNOW DEPTH

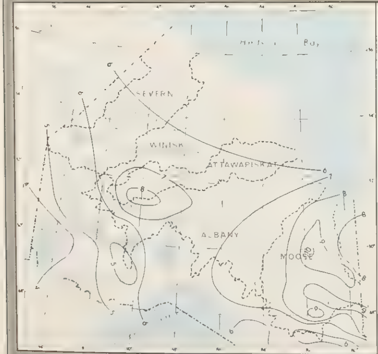
IN INCHES

SOURCES

CANADA DEPARTMENT OF TRANSPORT METEOROLOGICAL BRANCH 'SNOW COVER DATA' WINTER 1961-62, 1963-64, 1964-65 1965-66 1966-67

COMPILED BY

C.L.A. HUTTON, O.M GIERMAN AND E.A LACOSTE ECONOMIC GEOGRAPHY SECTION RESOURCES RESEARCH CENTRE



NORTHERN ONTARIO RESOURCES

MEAN MAXIMUM WATER EQUIVALENT OF SNOW

IN INCHES

SOURCES CANADA DEPARTMENT OF TRANSPORT, METEOROLOGICAL BRANCH 'SNOW COVER DATA' WINTER 1961-62 1963-64 1964-65 1965-66 1966-67

NOTE

DATES OF OCCURRENCE OF MAXIMUM SNOW DEPTH AND MAXIMUM WATER EQUIVALENT DO NOT NECESSARILY COINCIDE

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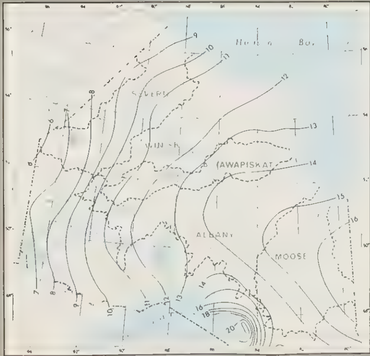

NORTHERN ONTARIO RESOURCES

MEAN ANNUAL RUNOFF

IN INCHES

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NORTHERN RESIDENTS

Population Ecumene

The first settlements in the Ontario arctic watershed were established at scattered posts of the Hudson's Bay Company in the late 17th and in the 18th centuries. Later, after the construction of railroads at the end of the 19th and in the early 20th centuries, a ribbon-like pattern of settlement developed along rail lines. This pattern is still apparent in Map 7, particularly through the Clay Belt and the southern Albany basin. These narrow discontinuous corridors cross the northern Ontario barrier to provide a tenuous link between the populated St. Lawrence Lowland and the Prairie Provinces. The construction of trunk highways in the 20th century has reinforced the ribbon-type of population pattern.

Mining and the pulp and paper industries have provided stimuli for development of other settlements in an open, dispersed pattern of distribution. North of the railway lines and beyond the reach of highways, the distribution of population, mostly Indian, was directly related to water routes. The bog and wetland areas of the Hudson Bay Lowland were, in 1968, almost unpopulated except for coastal settlements at the mouths of the major rivers located on sites that were elevated above flood waters. The distribution of population in the region for 1966 is shown on Map 7.

In 1966, the estimated population for the region was about 121,000, constituting 1.7 per cent of the Ontario population. The distribution and proportion of Indian and non-Indian populations are shown in the "Population" tables by basin for 1951, 1961 and 1966 on Map 7. Most of this population, 85.5 per cent, resided in the Moose basin (Table 2). Although the population of the study area increased by about 12,000 between 1951 and 1968, most of the growth occurred in the southern part of Moose basin; the proportions of total population in each basin have remained little changed.

According to questionnaire information from northern Indian agents, slightly less than 6 per cent (7,096) of the Indians lived on Indian reserves and settlements, although many respondents felt that this figure probably underestimated the total Indian population. About one-third of this number resided in each of the Severn and Albany basins, one-seventh in the Attawapiskat, one-eighth in the Moose and one-tenth in the Winisk basin. From 1951 to 1968 there was comparatively little change in the overall Indian population. In three basins, the Attawapiskat, Winisk and Severn, Indians comprised approximately 80 per cent of total population, whereas non-Indian peoples constituted 82.6 per cent of the population in the Albany basin and 99.2 per cent (102,558) in the Moose basin.

In 1968, in keeping with general Canadian trends, a process of rural-urban migration was proceeding in the region. The urban population accounted for 66 per cent of the population of the Ontario arctic watershed as opposed to the national level of 73 per cent. This population had increased from 60 per cent in 1961 to 66 per cent in 1966, but the total population increased by only 1 per cent. The Albany and Moose basins were most highly urbanized; the Moose basin contained approximately 70 per cent of all urban population in the region. It is anticipated that the growth of larger urban centres will continue, with a concurrent decline in the population of smaller centres and rural areas.

TABLE 2. Population distribution by watersheds, 1966 (%)

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total
Indian	2.0	0.5	0.8	1.8	0.7	5.8
Non-Indian	–	0.2	0.5	8.7	84.8	94.2
Total %	2.0	0.7	1.3	10.5	85.5	100.0

Mining and other single resource-based industries should be major factors in attracting residents to the study area. Aside from the most southerly settled areas, the distribution of population, therefore, is expected to remain widely dispersed and comparatively mobile.

Selected Socio-Economic Characteristics

In Map 8, each river basin is shown with five diagrams indicating selected socio-economic factors. Some striking variations among the basins are evident, particularly in educational levels and occupational composition. Significant variations in both income and labour are indicated.

About 7 per cent of the people of the Ontario arctic watershed were of pre-school age; but a further 13 per cent had no schooling; 52 per cent had elementary schooling, 24 per cent had a high school education and only 2 per cent were reported to have obtained a university education. With respect to the non-Indian portion of the population, there was considerable similarity among the basins in the proportion of people at various educational levels: 18 per cent had no schooling, 45 per cent had only elementary education, 30 per cent had a high school education, and 5 per cent had a university education. As indicated on the map, the Winisk basin was an exception due to the number of technical personnel at a former radar base. In each basin the proportion of the Indian population attaining each level of education was in sharp contrast to that of non-Indians. Only 2 per cent of Indians were educated beyond the elementary school level; 38 per cent had elementary schooling, but 60 per cent had no schooling (Map 8).

Birth rates for Canadian Indians, however, were higher than the national average, but the rate of increase in the Indian population appeared to be only about one-half that of the general population of the study area. This conclusion can be advanced only tentatively, however, because of a scarcity of accurate data concerning Indian population distribution and mobility.

In the study region, males outnumbered females by a ratio of 1.15 to 1, the highest in Ontario. This condition is also characteristic of the non-Indian population in many parts of northern Canada where the economy is based on primary resource extraction. The sex-age pyramids are uneven columns generally indicative of a slow-growing population; about one-half of the population is over the 20-24 year bar.*

TABLE 3. Wage earners by earnings, 1961 (%)

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total (%)
Under $3,000	48.4	19.1	38.0	35.4	40.2	39.6
$3,000-$5,999	50.0	46.4	55.9	48.1	51.4	51.1
$6,000-$9,999	1.6	31.7	6.1	15.7	7.6	8.5
$10,000 and over	–	2.8	–	0.8	0.8	0.8
Wage earners as % of population 15 years and over	5.1	36.1	28.4	46.1	44.6	45.2

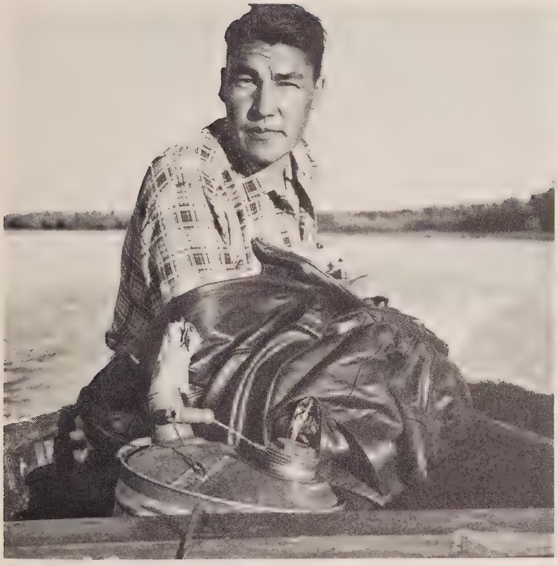
Note: Population 15 years and over, 74,447; wage earners, 33,623; aggregate earnings, $111.5 million

The labour force, people of age 15 and over, constituted 62 per cent of the total population in 1961, however, wage earners constituted less than half of the population.

Table 3 expresses as percentages the statistical data from the table, "Wage Earners by Earnings 1961," (Map 8).

*It is important to note that the statistics used in the age-sex pyramids shift from a 5-year interval up to age 24 to a 10-year interval between ages 25 and 65.

Guiding is an important activity of some Indian groups.



It indicates that most of the wage earners were located in the Moose and Albany basins, with fewest in the Severn basin. In all basins approximately one-half of the wage earners fell in the $3,000-$5,999 category and, with the exception of Winisk,* one-third to one-half were in the "under $3,000" category.

The average earnings derived by wage earners in 1961 are shown on the table, "Wage Earners by Earnings, 1961" (Map 8). Earnings varied from $2,741 in the Severn basin to $5,008 in the Winisk basin; the average for the region was $3,317.

Table 4 provides further insight into earnings: the Moose basin accounted for 87 per cent of the aggregate earnings of the region and the Albany, 11.3 per cent. Each of the other basins generated less than 1 per cent of total earned income, indicating greater opportunity for earned income in the Albany and Moose basins. The low per capita income of $77 in the Severn basin, for example, indicated that there were few wage earners in relation to the population.

*Winisk was an exceptional case because of the former presence of the Winisk radar base, which contributed heavily to a greater-than-average proportion of population with advanced education.

TABLE 4. Selected characteristics of earnings, 1961

River basin	Aggregate earnings by basin (%)	Average wage earnings per capita ($)
Severn	0.2	77
Winisk	0.8	997
Attawapiskat	0.7	550
Albany	11.3	1,001
Moose	87.0	946
Regional total	100.0	932

In 1961 the average earnings of male workers in each basin, except the Winisk, were about $3,500. In the Winisk basin, average male earnings were $5,100. Although females constituted 45 per cent of the labour force, only 17 per cent reported earnings. The average income of female wage earners was $1,700.

Average per capita income in the study area in 1961 was $932; in contrast, the average per capita income for Indian residents (in 1968) was only $194.* Thus, on an unadjusted basis for the 1961 and 1968 data, the average per capita Indian income was about one-fifth of the regional average. Low Indian incomes are typical of many areas of northern Canada, and although incomes are supplemented by various forms of social assistance payments from federal and provincial governments, total earned income fails in many cases to exceed amounts considered in southern Canada to be poverty levels. This theme is developed further in the following section.

Characteristics of Indian Earnings

Earned income of most Indians often depended on a cycle of economic activities rather than on a fixed wage.† Table 5 shows that of the estimated earned income of $1,533,000 in 1968 the largest amount, 43 per cent, was

*Income for Indian residents was compiled from information supplied by northern Indian Agents, Department of Indian Affairs and Northern Development.

†"Earned income or earnings" refers to income from all sources except government transfer payments or social assistance, such as unemployment insurance, family allowance or welfare. Since in northern areas these sources of income may be just as important as wages or other earned income from self employment, the distinction is significant.

TABLE 5. Selected characteristics of Indian earnings, 1968

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total
Earnings (in thousands of dollars)	656.5	113.1	22.0	240.4	501.0	1,533.0
Earnings (%)	43	7	1	16	33	100
No. Indians employed	835	101	55	248	201	1,440
Average earnings ($)	786	1,120	400	969	2,493	1,065
Average earnings/capita ($)	227	176	27	145	265	194
Ratio of employed to population	1:2.9	1:6.6	1:17.9	1:8.9	1:4.1	1:4.9

TABLE 6. Estimated Indian earnings by occupations, Ontario arctic watershed, 1968
(Total earnings $1,533,000; totals rounded to nearest percentage)

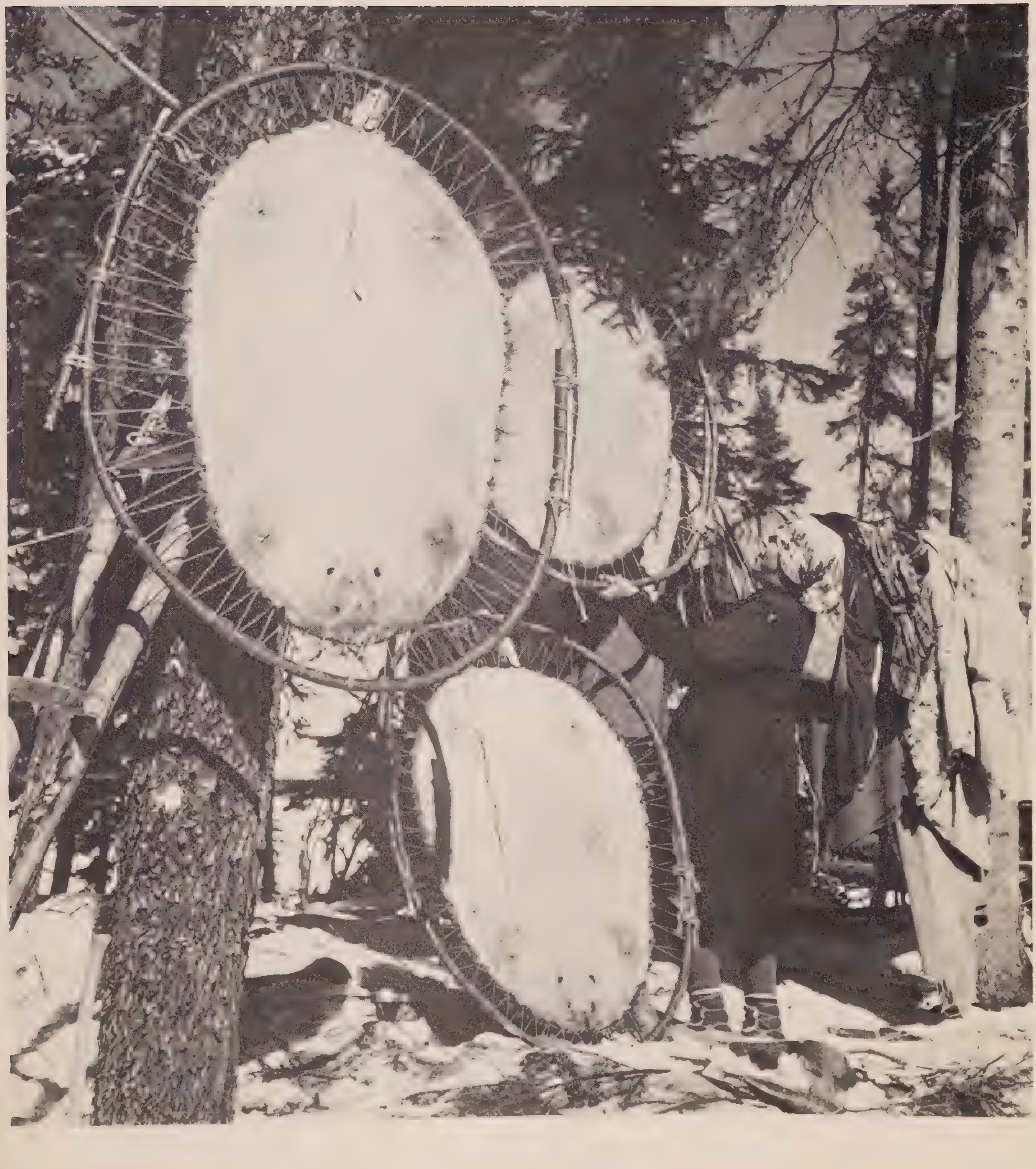
	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total (%)
Mining	1.0	–	–	–	–	1
Logging	1.0	0.3	–	1.0	1.5	4
Fur trapping	10.0	2.5	1.3	2.6	2.8	19
Commercial fishing	9.0	2.3	–	5.5	–	17
Tourist guiding	1.4	0.2	0.1	1.0	0.7	3
Labourers	17.0	2.0	–	4.0	20.0	43
All others	4.0	–	–	1.6	8.0	13
Proportion by basin	43	7	1	16	33	100

TABLE 7. Estimated Indian earnings by occupations, 1968 (in thousands of dollars)

	Severn		Winisk		Attawapiskat		Albany		Moose	
Occupation	(a) $	(b) %	(a) $	(b) %	(a) $	(b) %	(a) $	(b) %	(a) $	(b) %
Mining	15.0	2								
Logging	13.5	2	5.0	4			15.0	6	23.7	5
Trapping	147.0	22	39.0	35	20.0	91	40.5	17	43.0	9
Fishing	136.5	21	35.0	31			85.0	36		
Guiding	21.0	3	3.3	3	2.0	9	15.0	6	10.3	2
Labour	260.0	40	30.6	27			60.0	25	303.2	60
Others	63.5	10	0.2				24.9	10	120.8	24
Total earnings	656.5	100	113.1	100	22.0	100	240.4	100	501.0	100

(a) Occupational earnings by basin (total $1,533,000)
(b) Proportion of earnings by basin (rounded to nearest per cent)

Beaver skins being cured in preparation for market.



derived from the Severn basin and only 1 per cent from the Attawapiskat basin. The estimated income earned by Indians in that year constituted only about 1.4 per cent of the region's 1961 total aggregate earnings of $111.5 million.*

Estimated Indian earnings of the Ontario arctic watershed averaged $1,065 in 1968 (Table 5). Average earnings ranged from $400 for the Attawapiskat Indian to $2,493 for the Moose basin Indian. On a per capita basis, average income amounted to $194 per person and ranged from $27 per person in the Attawapiskat basin to $265 in the Moose basin. The Indians of the Severn basin had the highest ratio of employed with about 1:3 persons; those of the Attawapiskat had the lowest with only 1:18 reported as being wage earners.

A detailed distribution of estimated earnings by occupation for the Ontario arctic watershed is given in Table 6. Indians employed as labourers accounted for about 43 per cent of all estimated earnings of the study area; of this amount the Moose basin contributed 20 per cent and the Severn basin, 17 per cent. Fur trapping, in second place, contributed about 19 per cent of earnings and commercial fishing, 17 per cent. Generally, earnings derived from mining and logging activities were negligible, however, it is worth noting that 8 per cent was derived mainly from clerical and nursing occupations in the Moose basin.

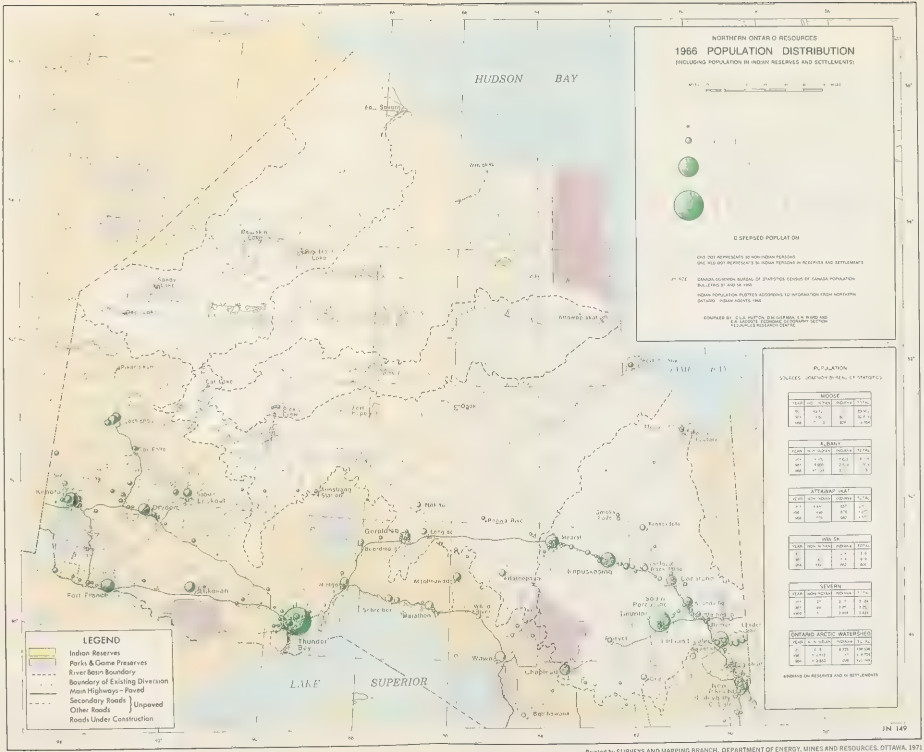
TABLE 8. Average earnings derived by Indians from labour, 1968

Severn	$1,625
Winisk	987
Attawapiskat	–
Albany	1,364
Moose	3,407
Regional average	2,018

When occupational sources of income are compared on a basin-by-basin basis as in Table 7, the importance of all sources of income is demonstrated. As sources of earned income, fur trapping accounted for 91 per cent in the Attawapiskat basin; fishing and labour constituted 61 per cent in the Albany basin; trapping, fishing and labour accounted for 93 per cent and 83 per cent of all earned income in the Winisk and Severn basins respectively. Indians employed as labourers accounted for 60 per cent of all earnings in the Moose basin.

Indians provided a pool of unskilled labour, so that activities relating to railway, construction, road and janitorial services were important to them as sources of income. Such occupations have generally provided a higher-than-average income for the Indian wage earner (Table 8).

*Data presented in Tables 5 to 8, 11, 13, 16 and 19 should be considered as estimates only.



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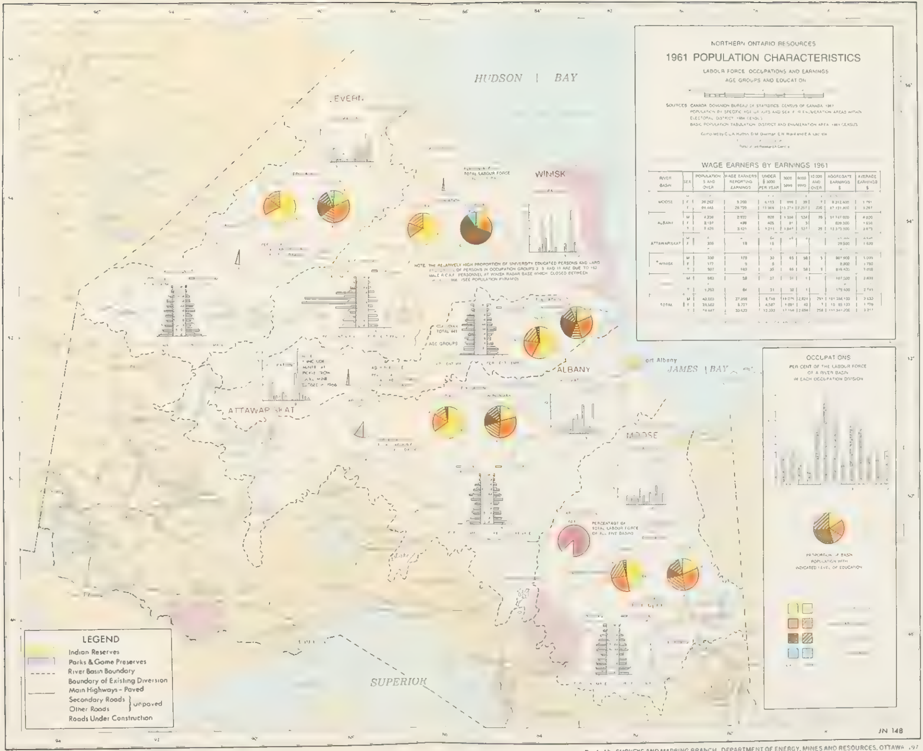

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RESOURCES AND ECONOMIC ACTIVITIES

Mineralized Areas

All mines in the Ontario arctic watershed are associated with belts of folded and metamorphosed volcanic and sedimentary rocks. While the distribution of mines (Map 9) has of course been influenced by the accessibility of mineral occurrences, the intensity of exploration was also vital. Consequently, most mines are situated in the southern part of the study area. The most thoroughly explored and developed part is the region centred in the Timmins-Porcupine-Matheson district of the Moose River basin, an area long famous for gold production. During 1969, 10 mines in that basin were producing a range of minerals, primarily gold, copper, lead and zinc. During the same year, two gold producers and a copper mine were closed. Since then, the number of gold producers has decreased further, although recent price increases for gold may reverse this trend. A new copper mine and an asbestos mine were commencing production. A further asbestos deposit and a copper-zinc orebody were also being developed.

The four other basins had only two mines among them: a gold mine near Geraldton in the southern Albany and a new producer of gold, silver, lead and zinc, which was being developed in the Severn basin.

Most metallic ores have several metal components. While gold is usually mined alone, copper ore, for example, most often contains zinc and lead as major components; silver also occurs as a component of these and other ores. Although the existence of component minerals tends to diminish risk and reduce the cost of mining normally involved in the extraction of a single mineral, it also makes the production policy for individual minerals less flexible, since a change in rate of production of one automatically affects that of all others.

TABLE 9. Average grades of metallic ore mined

Metal	Average grade	Range of grades
Gold	0.231 oz./ton	0.113 to 0.400 oz./ton
Silver	5.40 oz./ton	3.00 to 7.81 oz./ton
Copper	1.71%	0.79 to 2.70%
Zinc	5.49%	2.99 to 9.00%
Lead	1.18%	0.30 to 2.06%

Table 9 summarizes average grades of ore mined in the late 1960's.

Known ore reserves and rates of production for the region are summarized in the table "Mineral Production and Ore Reserves by Basin 1967" (Map 9).

Development of Mining

Most of the early exploration and mineral development was for gold. Major discoveries first occurred in 1909 and led to rapid development of the well-known Dome, McIntyre and Hollinger mines. By 1968 over $1.5 billion in gold bullion had been produced in the Moose basin, mainly from the Timmins-Porcupine area, where gold was the mainstay of the economy until the 1960's. In 1968, however, only six gold mines continued to operate, about one-half the number operating five years earlier. Closures were due primarily either to exhaustion of orebodies or to increasing costs of production. In the Moose basin, aside from the Timmins-Porcupine area, only the Renabie gold mine was operating. It started production in 1941; by 1968 it had produced just over $25 million in gold. In 1967, Texasgulf, a spectacular base metal mine located about 16 miles north of Timmins, came into production. It is the world's largest producer of zinc and silver, and one of the world's principal copper producers. Ore reserves exceed 90 million tons.

The only other operating mine in the study area in 1968 was a gold producer (since closed) near Geraldton in the Albany basin. Before 1968, six other mines in the Nakina-Geraldton-Longlac area had closed. In the Attawapiskat basin, two gold mines opened in the early 1930's: one was closed in 1951 and the other in 1966 after total production for both mines of $53 million. In the Winisk basin, comparatively little mineral exploration had been conducted and no mines had been developed. In the Severn, one mine at Favourable Lake (gold-zinc-silver-lead) had produced a total value of $9.4 million from 1939 to 1948. Production was expected to resume in 1969.

Since 1948, the gold mining industry has received financial assistance from the Government of Canada under

Prospecting methods have changed over the years.

The Emergency Gold Mining Assistance Act of 1948 (Canada, 1970). Beginning in December 1967, the act has been extended by periods of three years and is now in effect until at least 1976. The impact of the Assistance Act on northern gold mining communities, such as Holtyre, Timmins, Schumacher, South Porcupine, Pamour and Renabie, has been considerable.

Asbestos was first produced in 1958 near Matheson, but the mine was closed in 1964. Early in 1968, a new asbestos mine opened near Timmins. Value of production that year was $2.3 million. Another asbestos mine near Matheson was scheduled to start operation early in 1969. All were in the Moose basin.

The total value of minerals produced in the region in 1967 was $301,300,000, which was 6.8 per cent of the value of total national mineral production and 25 per cent of the total for Ontario. Almost the entire value of production, 99 per cent, originated in the Moose basin, mainly in the Timmins area. The remaining 1 per cent was produced in the Geraldton area of the southern Albany basin. In the same year, 91 per cent ($274,183,000) of the value of the total mineral output was derived from base metals, production of which started only in 1961; the other 9 per cent was from gold. Asbestos output was negligible in 1967. All base metal concentrates produced in the study area were shipped to smelters outside the region, principally in Japan, Sweden, U.S.A. and Noranda (Quebec).

As an occupational group, miners and quarrymen accounted for 12 per cent of all wage earners in the region; the largest number, 4,268, were located in the Moose basin (Table, "Miners and Quarrymen 1961," Map 2).

Mineral Exploration

In the past, gold and silver provided the greatest stimuli to exploration for minerals. Since the development of large deposits of base metals in the Moose basin near Timmins, the emphasis has shifted considerably. Most exploration and staking activity was centred in the Timmins area, which was well explored in comparison with most of the study area. In the other basins, exploration and staking was concentrated in the southern portion of the Shield area. Staking had occurred at Bamaji Lake, Big Trout Lake, Ogoki, Savant Lake, Marshall-Summit Lakes, Hewitt, Stoughton and McVicar lakes, South Bluff Creek, Gogama, Melchett Lake and Favourable Lake (Map 10). The discovery of new orebodies still depends to an important degree on the prospector searching the rocks for minerals.

The table "Miners Claims Recorded and Cancelled 1963-1968," on Map 10, shows the amount of staking that occurred in this period. It also shows that following a staking rush many claims are dropped: only those requiring further investigation are retained. The large number of claims staked in 1964 resulted from the silver discovery by Texasgulf in Kidd Township, north of Timmins, when over 20,000 claims were staked in the area (Matten, 1970).

Gold provided the main stimulus in the early development of mining of the Ontario arctic watershed.

In addition to the well-known metallic ores, the Moose basin was also being explored and further evaluations were being made of known occurrences of clays, silica sand, gypsum, marl, anhydrite, calcium sulphate, and in an area south of Moosonee, of lignite. Other minerals, such as iron, uranium, columbium and diamonds, were also widely sought.

Exploration for oil and gas had been proceeding over an area of approximately 4 million acres in the Hudson Bay sedimentary lowlands in the northwest corner of the province and in an area southwest of Moosonee. In Manitoba, one well had been drilled to the Precambrian rock underlying the sedimentary rocks of the Lowland.* No hydrocarbon indications were found, but there was a possibility of more encouraging results in thicker beds farther east.

*In 1968 an exploratory well was drilled down to bedrock in the Manitoba part of the Lowland. Little information has been released concerning the oil-bearing qualities of the strata penetrated by the well.

Factors Affecting Mineral Exploration and Marketing

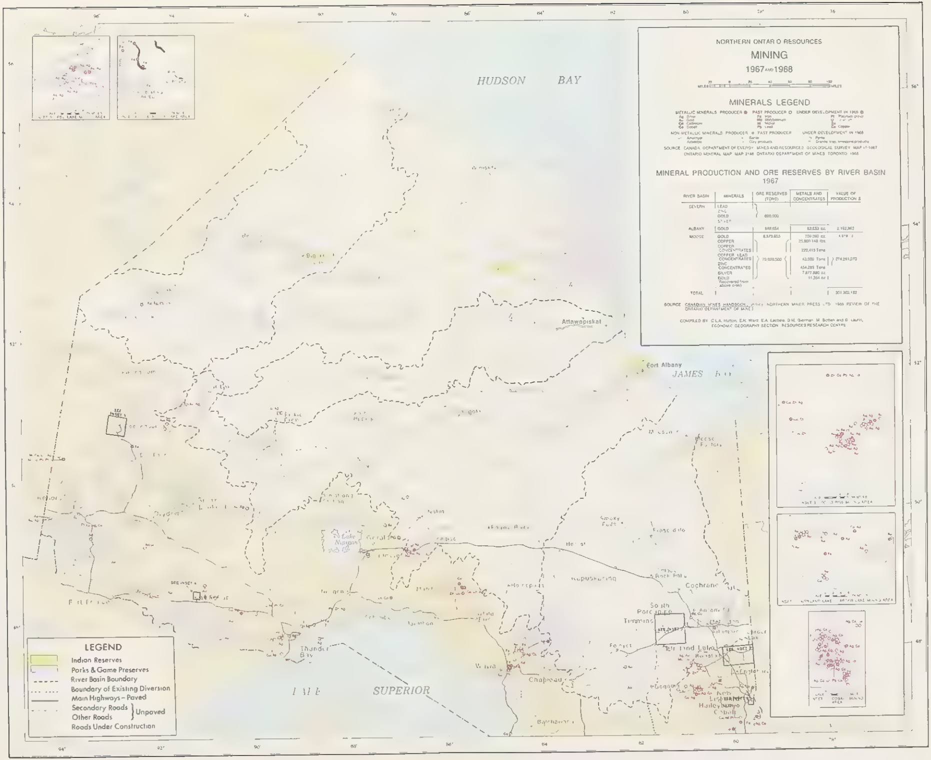
As indicated previously, most mining and exploration activity occurred in the south, particularly in the more accessible parts of the Moose basin. The search for iron, uranium, base metals and oil and gas had, however, stimulated a northward movement of exploration. Most of the James Bay-Hudson Bay drainage area in Ontario is a virgin region for this activity, although in recent years provincial and federal governments have been conducting extensive geological surveys in the northern part of Ontario, particularly north of 52° N latitude.

Construction of new access roads northward from Cochenour and Central Patricia toward Lingman Lake was expected to have considerable effect on mineral exploration in the northwestern part of the study area.

It is much more difficult to indicate trends that may result from shifts in technology and economics. Either the non-renewal of the Gold Mining Assistance Act or the increased price of gold, for example, would have a substantial impact, both on overall rates of production and on the mining towns themselves. Improved treatment methods or increases in market prices would result in re-opening some mines and extending the life of others. The recovery of "new" minerals could be initiated: tin, for example, could be extracted from some lead-zinc ores in the Moose basin. If suitable methods were found to remove silica, extensive kaolin deposits south of Moosonee could be utilized. In the same area, at Onakawana, increasing interest was shown in large deposits of lignite, particularly for generation of thermal-electric power. There were known reserves of 1.3 billion tons of relatively low-grade iron ore in the study area. In the future, iron mines could be located at Lake St. Joseph, Kowkash and at Melchett Lake, near Timmins.

The mining industry utilized 83 billion gallons of water per year during the late 1960's, accounting for 74 per cent of total man-made water demand. Most of the water was used in the processing of copper, zinc, lead, gold and silver ores. Iron ore processing may cause a large increase in water demand in the future; the concentrating and pelletizing plant of the Iron Ore Company of Canada at Labrador City in the late 1960's was using 40,000 gallons a minute. Asbestos mining and processing is a relatively dry process, however, requiring very little water. It was not known how much water was being discharged from mine operations, or the consequent effects on surface streams or groundwater, or upon freshwater biota and wildlife of the region.

There are a number of important constraints on mineral processing, imposed by refineries and smelters located in the United States, Japan and western Europe, that affect the economic welfare of people of the region and the province (Drolet, 1972). Tariffs are employed by these nations to assure adequate ore concentrates and to discourage the establishment of processing facilities in the product's country of origin. Consequently, it is difficult for Canada, one of the world's largest mineral producers and exporters, to sell refined metal; it is not difficult to dispose of ore or concentrates. Nevertheless, studies are being made of the feasibility of constructing zinc and copper smelting and refining facilities in Ontario.



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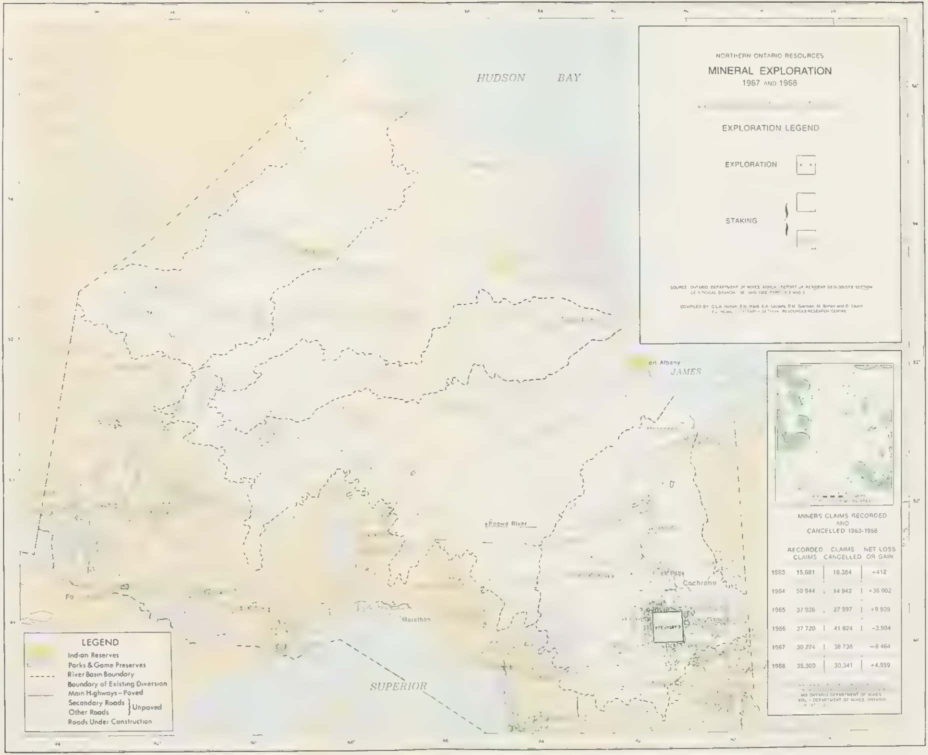


	RECORDED CLAIMS	CLAIMS CANCELLED	NET LOSS OR GAIN
1963	15,681	16,384	+412
1964	50 944	14 942	+36 002
1965	37 936	27 997	+9 939
1966	37 720	41 624	−3,904
1967	30 274	38 738	−8 464
1968	35,300	30,341	+4,959

Cartography by POLICY RESEARCH AND COORDINATION BRANCH

Forest industries

The Forest Base

The Ontario arctic watershed, in terms of Halliday's forest classification, is divided into two broad regions (Rowe, 1972). First, the boreal forest and barrens of the poorly drained Lowland and second, the boreal forest of the better-drained Shield. The forests are primarily coniferous species with a general admixture of birch, trembling aspen and balsam poplar.

The dominant species of the Ontario arctic watershed vary locally and regionally depending on drainage, soils, relief and climate. On the better-drained river banks of the Hudson Bay Lowland, forests of white spruce, balsam fir, trembling aspen, balsam poplar and white birch occur. Their greatest concentrations are found in the vicinity of the major rivers south of James Bay; the quality of the forest is similar to that of the Clay Belt and adjacent areas. To the northwest the prevalent forest consists of stunted black spruce and tamarack. White spruce forms the maritime treeline along the northern edge of the Lowland. South of the Lowland and in the upper Moose basin, the Clay Belt is marked by a seemingly endless expanse of black spruce that covers gently rising slopes and hills, as well as low-lying flats. Between the height of land and the Lowland, and across northwestern Ontario, black spruce is the predominant tree; it occurs in stands on the thin soils of the uplands as well as on the poorly drained, low-lying areas. Between these two positions it is associated with either jack pine or tamarack. In river valleys, on southward-facing slopes and more favourable soils, white spruce, balsam fir, trembling aspen and balsam poplar form mixed stands.

Frequent fires have favoured the spread of jack pine and white birch. In the Moose basin, jack pine has a dominant position in the drier outwash deposits, beaches, eskers and coarse-textured soils; white birch is prominent on sandy soils. Balsam poplar and white spruce appear to be correlated to lime content in calcareous drift, morainic loams and clays. The northern range of trees and outposts of southern trees, such as white elm, red pine, eastern white cedar and sugar maple, are shown on Map 12.

According to commercial utility, the Ontario arctic watershed may be divided into three major regions (Map 12). First, the Clay Belt and the headwaters of the Moose, Albany and Kenogami rivers supported most of the study region's forest industries. Most of this area has been leased to lumber and paper companies. Though more heavily exploited than the other parts of the study area, only 15 per cent of the allowable cut was utilized. The coniferous spruce and jack pine species made up over 90 per cent of the total cut. The deciduous hardwoods, white birch, and poplar were even less utilized, with a total cut of less than 5 per cent of the allowable limit over most of the area. The region, therefore, has considerable potential for increased output.

Trees in the 4- to 9-inch-diameter range were used for pulpwood, poles, pit props and railway ties. Only those 10 inches and larger were used for sawlogs and construction timbers. About two-thirds of the total standing mature forest was considered usable as pulpwood and one-third as sawlogs. About one-third of the mature softwoods, mainly black and white spruce, was classed as usable for sawlogs, while more than one-half of the mature hardwoods, mainly poplar, was considered usable for this purpose.

The second commercial forest region encompasses the Shield area of the Severn, Winisk, Attawapiskat and middle Albany basins. Very little of the area had been licensed for cutting. The allowable annual cut was set at 2 per cent of the primary growing stock: for softwoods it was set at 1.8 per cent and for hardwoods, 3.3 per cent. About 15 per cent of the primary growing stock was classed as usable for sawlogs and the remainder for pulpwood. The area remained largely inaccessible except by gravel road into the Pickle Crow area. This region also presents a marked potential for increased wood output.

The third region, the least significant for commercial forestry, is the Hudson Bay Lowland. The only accessible portion was along the Ontario Northland Railway to Moosonee. The rest of the area is almost impossible for travel in summer. Some potential for forest exploitation may exist, however, in the long, narrow strings of forest that occupy the better-drained banks bordering the main rivers.

Typical transition forest of the upper English and Albany headwaters region between the boreal forest to the northeast and the Great Lakes—St. Lawrence forest to the south.

Logging and Sawmilling

Most logging activities were part of larger integrated company operations; comparatively few logging companies and private individuals operated independently. The sawmilling industry had long been established in the settled parts of the Moose basin in association with agriculture and mining. In the late 1960's, logging operations were still confined mainly to the settled southern areas of the Moose and Albany basins (Map 11).

There were 33 sawmilling establishments, which produced in the 1965-67 period a total output greater than 340,000 thousand board feet (Mbm): 24 were situated in the Moose basin, 7 in the Albany, and 2 in the Severn. As indicated on Map 11, 10 large mills in the Moose basin and 3 in the Albany basin accounted for the bulk of production. On that map, the table "Lumber Output by River Basin, 1965, 1966 and 1967" shows that the average annual output was about 149,000 Mbm in the Moose, 62,000 Mbm in the Albany, and only 29 Mbm in the Severn basin. Total value of output was about $27,000,000 a year or 13.7 per cent of the value of all wood products (Table 10). Spruce and jack pine accounted for 90 per cent of the production. An increasing number of plants were installing chipping mills, with the output destined for pulp and paper plants.

Pulp, Paper, Plywood and Chips

The location and output of wood products industries are shown on Map 12. On that map, accumulated output for 1965 to 1967 is given in the summary table "Volume of Wood Products."

The average annual value of all wood products, including lumber, is ranked in Table 10. Paper products led in value with a total share of 57.7 per cent; wood pulp was second with 26.8 per cent, followed by lumber and plywood with shares of 13.7 and 1.8 per cent respectively.

The pulp and paper industry was attracted to the region, not only by high-quality spruce pulpwood but also by the availability of large quantities of water for industrial use and power generation. Although several large mills were distributed across northern and northwestern Ontario, most of those of the study region were located in the Moose basin. Three methods of pulp production, known respectively as sulphite, sulphate and magnefite processes, were used. Average annual production of wood pulp for the three years 1965 to 1967 was about 427,000 tons, with an approximate value of $53,000,000 (Table 10).

Wood chips for use in the production of pulp and paper have in recent years become a new source of income for sawmills and plywood mills; materials formerly wasted became usable. In the Moose basin, average annual output for the 3-year period, 1965-1967, was 87,000 tons (dry) and in the Albany, 30,000 tons.

The main types of paper products manufactured were newsprint, wrapping paper, tissues and wadding products. During the same years, average annual production of these commodities was about 854,000 tons, with an approximate value of $114,000,000 (Table 10). Most of the output was exported to the United Kingdom.

TABLE 10. Average annual value of wood products, 1965-1967 (in millions of dollars)

	Value ($)	%
Lumber	27.0	13.7
Wood pulp	53.0	26.8
Paper	114.0	57.7
Plywood	3.5	1.8
Regional total	197.5	100.0

Mechanization of the woods operation has largely replaced the individual logger.

TABLE 11. Estimated earnings derived by Indians from logging, 1968

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total
Logging earnings (in thousands of dollars)	13.5	5.0	–	15.0	23.7	57.2
Logging as % of basin income	2.0	4.0	–	6.0	5.0	n.a.
Logging as % of regional income	1.0	0.3	–	1.0	1.5	4.0
Average earnings ($)	563	1,000	–	1,500	1,481	1,040

The newest wood-based industry in the study area was the manufacture of plywood. Average annual production for the same 3-year period was approximately 71,400,000 square feet, worth an estimated $3,500,000* (Table 10). The main tree species to be utilized were spruce, jack pine, poplar and white birch. Approximately 60 per cent of the total value of output was based on the use of poplar.

The proportion of earned income in 1968 derived by Indians from logging is shown in Table 11. Few Indians actually were engaged in logging. On a regional basis earnings were small, but by basins, logging is shown to be more important in the Albany and Moose basins than elsewhere in the region. Average income in 1968 derived from this source varied from a low of $563 for the Indian logger of the Severn basin to a high of $1,500 for the Indian logger of the Albany basin. In the Attawapiskat basin, local Indian logging activities were non-existent.

Trends and Technological Change

For the logging industry, the trend toward mechanization of logging operations, with the development of more efficient harvesting, transporting and processing equipment, was perhaps the most significant. Other significant trends involved a shift to year-round rather than seasonal operations and the development of a permanent specialized labour force with decreased dependence on part-time farm, mining and construction workers. These changes largely resulted from intense competition for international markets. Intensive management and high yields of southern U.S. pulpwood forests, for example, had reduced some traditional markets for eastern Canadian mills.

There was a trend toward fewer but larger sawmills and planing mills and a trend toward integrated operations. Chips were increasingly being used for particle board, pulp and paper. Mills were trending toward a 7-day work week, which would have the effect of increasing mill capacity and efficiency without additional capital investment.

Increased emphasis was being placed on reforestation; new techniques of seedling growth and transplanting had been developed. Other special techniques in forest management were being pursued to cope with problems such as rising water tables and rapid spread of sphagnum moss initiated by removal of merchantable black spruce. There was a trend to decreased use of log drives by water and to increased use of trucking.

Large quantities of water were used in the processing of pulp and paper, though the amount varied considerably among various mills according to the type of product and to the equipment and processes employed. During 1968, the total amount of water used by the pulp and paper industry in the study area was approximately 26 billion imperial gallons or 99.9 per cent of the total demands for water by all forest industries and 23 per cent of total water demand in the area. As a user of water, the pulp and paper industry was second only to mining. Aside from a comparatively insignificant amount (3 per cent) required for domestic and municipal use, these two industries accounted for almost the entire man-made demand for water in the Ontario arctic watershed.

*Calculated on the basis of sheets ¼ inch thick. Wood product information is summarized from records kept by the district offices of the former Ontario Department of Lands and Forests. Market value information was obtained from the Dominion Bureau of Statistics (now Statistics Canada) from which the latest available data was for 1966.

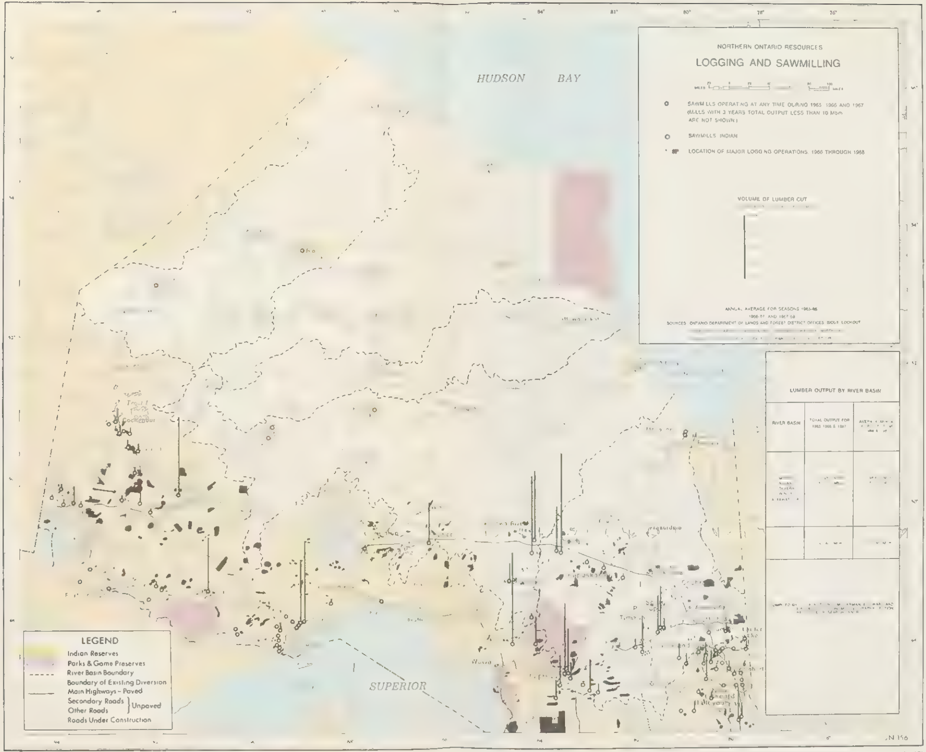
Lumbering in northern Ontario—the old and the new.

; in the mining industry, little was known of the ɔf the effluent from pulp and paper mill operations reshwater biota of the lakes and rivers of the region. ıagnefite process has reduced waste discharge prosince chemicals are reclaimed.* Other changes, such eduction of the toxic content of the effluent and recycling of industrial water, were being considered.

Almost all the even-aged forest stands in the boreal are the result of forest fires; in the past century, t 95 per cent of northern Ontario has been burned In the Ontario arctic watershed over 87,300 acres of t land were burned in 3,530 fires from 1966 to 1968.† important factors, a source of seed and suitable soil, id the natural rehabilitation of forests destroyed by fire.

Magnefite is the name applied to a chemical process employed by pulp and paper manufacturers.

†Personal communication—W.L. Sleeman, Director, Forest Fire Control Branch, Ministry of Natural Resources, Toronto, Ontario.



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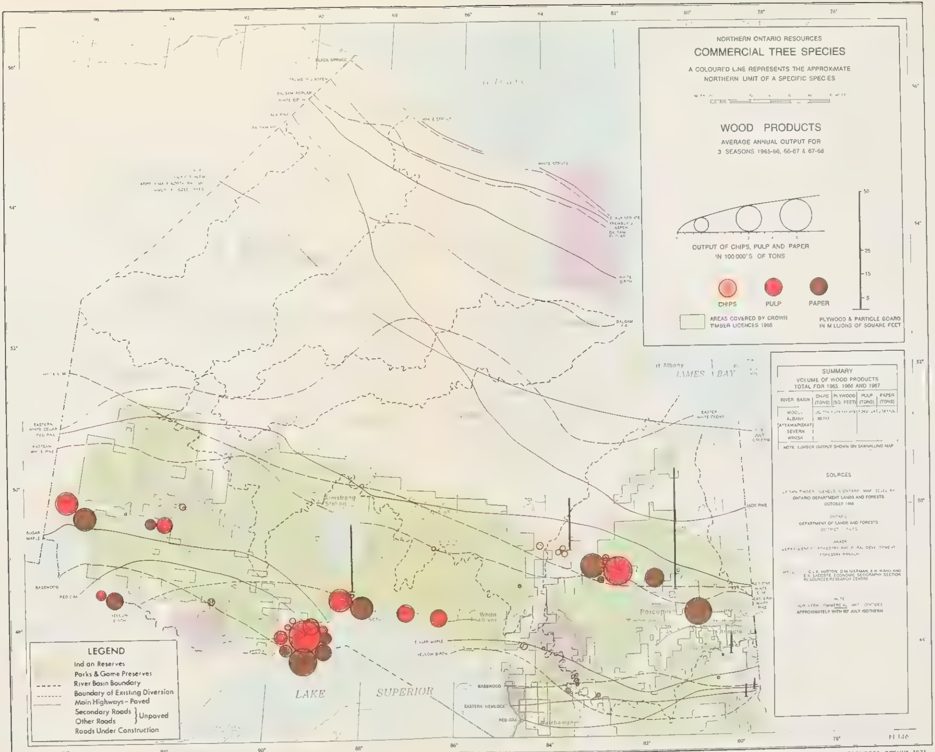

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Fur trapping

Wildlife Habitat

Wildlife, in addition to providing food, offers sources of income to northern residents through commercial fishing, recreation and tourism, and fur trapping. From a cash point of view, fur trapping is the most important.

The abundance, distribution and life cycles of fur-bearing animals are affected by such ecological factors as forest and tundra vegetation, the growing season, winter and summer temperature, permafrost, depth and consistency of snow cover, and food supply (Peterson, 1966; Moon, 1970). Marten, fisher and lynx, for example, inhabit only forested areas; mink tend to hunt the shores of streams. Beaver distribution is affected mainly by the distribution of food trees, such as balsam and aspen poplars, willow and alder; muskrat distribution, by the marshes adjacent to lakes and streams. The red squirrel is a coniferous-forest dweller; its staple food is white spruce cones.

The limited amount of new plant growth each year, in comparison with that of the south, restricts the abundance and diversity of animals in the study area. The comparatively short growing season limits the period for rearing the young and reduces both the number and size of litters per year. Cyclical fluctuations of mice, squirrels and hares affect the distribution of marten, fisher, lynx, fox and other animals.

In the permafrost area, excavation of dens and burrows is restricted to a short period in late summer. In the tundra and muskeg, muskrats inhabit burrows in the banks of lakes, ponds and sluggish streams. The fact that predators find it difficult to dig in the permafrost affords protection for small prey. Air in the coniferous forest is comparatively still; wind chill is not as important a feature of the wooded environment as it is on the tundra where it can have severe effects on exposed animals. The effect of snow on the mobility of many species has led to physical adaptations, such as the large padded claws of the lynx, the spreading hooves of the caribou and the long legs of the moose. Particularly dense, luxuriant coats provide fur-bearing animals with insulation against the arctic winter.

Most furs become prime in the fall when cold weather sets in. Mink, marten and long-haired fur-bearing animals that dwell in the "open" are in prime in November and December. Quality of fur tends to decrease with increasing length of daylight. The duration of winter storms has a bearing on fur quality; thus, when fox are "holed-up," urine stains reduce the quality of the fur. Muskrat reach their prime in March and April; their fur begins to deteriorate after mid-May. Beaver are prime throughout the autumn and winter. Basically, each fur animal has a period when fur is prime and offers the greatest cash inducement for the trapper.

Commercial Fur Harvest

Between 1965 and 1968 the average annual value of wild fur harvested exceeded \$1 million.* The average annual value by basin is summarized on Map 13. An examination of this map shows two major areas with differing levels of fur production: first, the area coinciding with the Lowland where the fur harvest is less than \$4.00 per square mile. The second area, the Shield, may be divided into two subareas: first, the southern Moose and southeastern Albany basins where the average annual value of fur catch per square mile ranged from \$8.00 to over \$12.00, and second, the Shield, occupied by the upper and middle basins of the Albany, Attawapiskat, Winisk and Severn rivers, which yielded an average annual fur harvest of \$4.00 to \$8.00 a square mile. Numerically, the dominant furs throughout the upper basins were muskrat and beaver, with mink in third place.

The table "Number of Pelts and Market Value for Trapping Seasons, 1965 to 1968" on Map 13 gives the distribution by species in the number and value of the fur catch by basin in the study area. The average annual market value of wild furs was almost \$1.1 million. By basins, the Albany led with 33 per cent of the value of the catch followed by the Moose with 26 per cent; Severn, 17 per cent; Winisk, 15 per cent; and the Attawapiskat, 9 per cent. The table emphasizes the impor-

*Value of fur harvest was computed from records in district offices of the former Ontario Department of Lands and Forests and from listed fur prices obtained at the annual auctions of the Ontario Trapper's Association at North Bay.

Both numerically and in value of catch beaver pelts are the most important fur taken in the Ontario arctic watershed.

tance of beaver in the trapping economy. In the three northernmost basins, muskrat was numerically the most intensively trapped species, while beaver predominated in the Albany and Moose basins. Marten was the second most important commercial fur by value in the Albany and Moose basins, accounting for about 11.2 per cent and 18.5 per cent of total catch per basin respectively.

The total number of pelts and accumulated market value of the catch for the years 1965 to 1968 are shown in Table 12. Beaver accounted for 38.5 per cent of the number of pelts harvested and about 67 per cent of the value of all furs marketed. Muskrat, which accounted for 37.9 per cent of the volume of fur, contributed only 5.6 per cent by value. In the "other furs" category, otter with 8.8 per cent, marten 8.7 per cent and mink 7.3 per cent, surpassed the marketed value of muskrat.

numbers of individual trappers; alternative sources of income; the international aspects of marketing; the individuality of the fur-garment processing industry and, in recent years, fur substitutes. Furs with the most stable average prices during the decade preceding 1969 were fox, with a price variation of 48 per cent, and beaver and mink, each with 62 per cent. During the same period, prices for lynx varied by 412 per cent, muskrat by 259 per cent, squirrel by 240 per cent and marten by 216 per cent.

The Indian Fur Trapper

Indians were the population group most dependent on fur trapping as a source of cash income. The dependence of northern residents on furs began with the

TABLE 12. Number and market value of leading pelts, 1965-1968

Category	No. of pelts	% of total pelts	Value of pelts ($)	% of total value
Beaver	140,947	38.5	2,180,451	66.9
Muskrat	138,805	37.9	181,834	5.6
Other furs	86,151	23.6	897,624	27.5
Regional totals	365,903	100.0	$3,259,909	100.0

TABLE 13. Estimated earnings derived by Indians from trapping, 1968

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total
Fur earnings (in thousands of dollars)	147.0	39.0	20.0	40.5	43.0	289.5
Fur as % of basin income	22.0	35.0	91.0	17.0	9.0	n.a.
Fur as % of regional income	10.0	2.5	1.3	2.6	2.8	19.0
Average earnings ($)	588	557	500	476	694	571

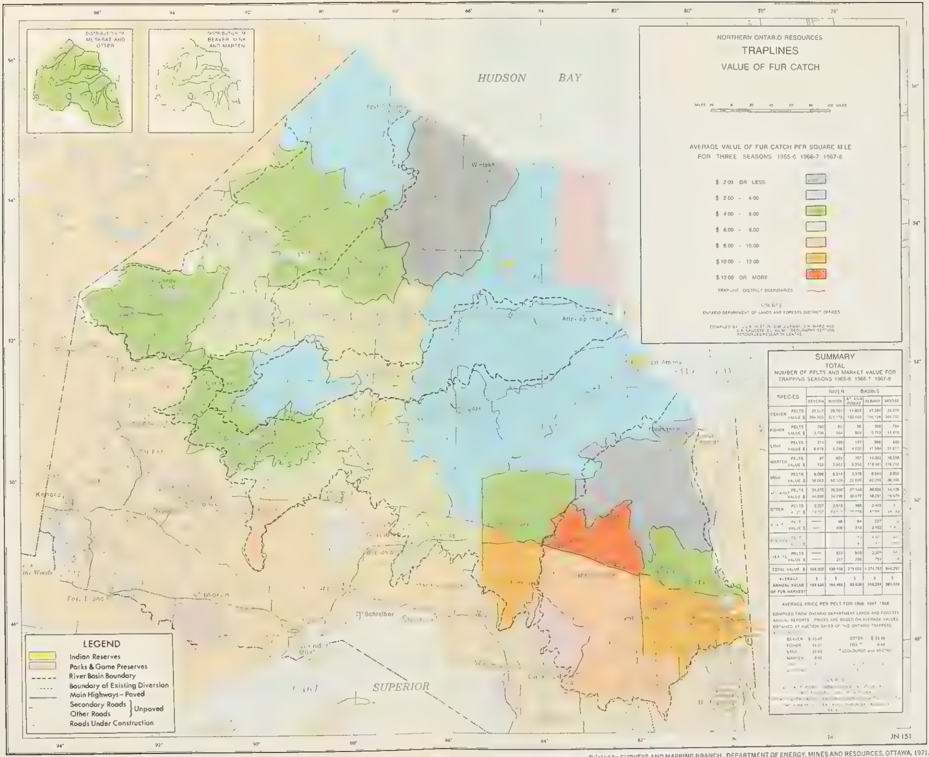
Supply and demand have historically been unpredictable and fur-price stability poor. This condition reflects both the nature of the market and the product, both of which are affected by such factors as cyclical and irregular production of wild fur, which varies considerably from year to year; the changing whims of fashion; the wide variability in the quality of pelts produced by large

expansion of the Hudson's Bay Company posts throughout the region in the 17th century. The Albany and the Moose basins were particularly noted for beaver, marten, mink and otter pelts. Originally, the Indians, in exchange for furs, received trade goods and supplies to pursue their trapline economy; money seldom changed hands. The subsequent development of the market econo-

my brought about a greater dependence on money transactions and upset the Indian's traditional way of life.

During the late 1960's the Indian fur trappers contributed about 27 per cent of the total value of the fur harvest of the region; fur remained an integral staple in the Indian economy. Furs accounted for about 19 per cent of estimated earned income of the region. The proportions of their total earnings originating from this source are shown in Table 13. Fur was the leading source of earnings in the Attawapiskat basin and an important source of earnings in the Severn, Winisk and Albany basins. Fur earnings in 1968 ranged from \$476 to \$694. The greater diversified economy of the upper Moose basin provided other opportunities for Indians; whereas the lack of development elsewhere in the study area resulted in a greater dependence on fur trapping.

Trapping by non-Indians was confined mainly to the southern parts of the Moose and Albany basins. Although conditions for fur production were better in the south, trapping provided a relatively minor proportion of total earned income.



SUMMARY
TOTAL
NUMBER OF PELTS AND MARKET VALUE FOR TRAPPING SEASONS 1965-6 1966-7 1967-8

SPECIES		RIVER BASINS				
		SEVERN	WINISK	ATTAWAPISKAT	ALBANY	MOOSE
BEAVER	PELTS	25,547	20,761	11,859	47,584	35,219
	VALUE $	394,903	321,173	183,459	736,124	544,782
FISHER	PELTS	260	63	56	350	794
	VALUE $	3,730	534	809	5,712	11,415
LYNX	PELTS	211	199	127	398	683
	VALUE $	6,879	6,298	4,020	11,584	21,817
MARTEN	PELTS	87	423	707	14,069	18,556
	VALUE $	723	3,562	5,953	118,481	156,242
MINK	PELTS	4,098	6,214	2,378	6,544	3,802
	VALUE $	58,062	60,132	22,820	62,290	36,195
MUSKRAT	PELTS	34,373	26,030	27,540	36,636	14,108
	VALUE $	44,698	34,099	36,077	48,291	18,479
OTTER	PELTS	2,327	2,418	985	3,449	[illegible]
	VALUE $	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
FOX	PELTS	—	48	84	237	[illegible]
	VALUE $	—	436	713	2,182	[illegible]
[illegible]	PELTS			[illegible]	[illegible]	[illegible]
	VALUE $			[illegible]	[illegible]	[illegible]
[illegible]	PELTS	—	659	805	2,304	[illegible]
	VALUE $	—	217	266	791	[illegible]
TOTAL VALUE $		568,302	429,458	279,093	1,074,782	844,297
AVERAGE ANNUAL VALUE OF FUR HARVEST		$ 189,434	$ 144,485	$ 93,630	$ 358,284	$ 281,433

AVERAGE PRICE PER PELT FOR 1966 1967 1968

COMPILED FROM ONTARIO DEPARTMENT LANDS AND FORESTS ANNUAL REPORTS. PRICES ARE BASED ON AVERAGE VALUES OBTAINED AT AUCTION SALES OF THE ONTARIO TRAPPERS

BEAVER $ 15.47 OTTER $ 25.45
FISHER 14.37 FOX* 8.49
LYNX 31.65 *(COLOURED and ARCTIC)
MARTEN 8.42

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Commercial fishing

The Fisheries

Northern fish are characterized by firm flesh and slow rates of growth because of long periods of low temperatures, ice cover and reduced underwater light. The most significant commercial species were pickerel (walleye), whitefish, lake trout, pike and sturgeon, although other species were taken, such as goldeye, tullibee and chub, ling, carp, Menominee whitefish, smelt and rock bass. Sturgeon caviar was also harvested. The total value of fish caught in the years 1966 to 1968 was $1.4 million; the average annual value was $451,000. Map 14 indicates that most production came from the lakes and streams of the Shield and that the Lowland waters were relatively poor fishing areas.

Albany and 8.6 per cent in the Attawapiskat basins; pike, 3 per cent and 1.7 per cent in the Albany and Severn basins respectively; and lake trout accounted for 2.2 per cent in the Severn basin. The commercial catch of other species was comparatively minor.

The Northern Fisherman

The table "River Basins and Licence Holders for 1966, 1967 and 1968" on Map 14, gives the distribution of the catch by value and species for Indian and non-Indian licence holders of fishing rights. Table 15 expresses the commercial value of the catch in percentages by river basin for the 3-year period, and the proportion of catch between Indian and non-Indian fishermen.

TABLE 14. Percentage value of catch by leading species, 1966-1968
(Total cumulative value, 1966-1968: $1,354,263)

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total (%)
Pickerel	46.2	69.7	51.4	58.0	35.9	53.2
Whitefish	48.3	28.0	38.6	29.7	17.0	38.0
Other species	5.5	2.3	10.0	12.3	47.1	8.7
Total %	100	100	100	100	100	100

TABLE 15. Value of total catch by Indian and non-Indian fishermen, 1966-1968
(Expressed as percentage of total value: $1,354,263)

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total (%)
Indian catch (%)	82.3	94.0	80.3	32.4	15.9	65.8
Non-Indian catch (%)	17.7	6.0	19.7	67.6	84.1	34.2
Basin catch (%)	43.0	12.6	9.7	32.3	2.4	100

Table 14 shows the value of the catch, listed by leading species, in the river basins of the study area for the 3-year period, 1966-1968. Pickerel and whitefish provided the main value of the catch in all basins except the Moose. There also, pickerel headed the list, but the value of sturgeon (36.4%) exceeded that of whitefish. In the "Other Species" category, the catch of sturgeon accounted for 7.5 per cent of the value of the catch in the

The upper Severn led in commercial fishing with 43 per cent ($583,000) of the total catch followed by the Albany with 32.3 per cent ($437,000). The Moose basin, the lowest producer, contributed only 2.4 per cent by value ($33,000) of the total catch in the study area. The value of the average annual catch by fishing licence was as follows: Severn–$3,890, Winisk–$2,700, Attawapiskat–$2,565, Albany–$2,200 and the Moose–$1,230.

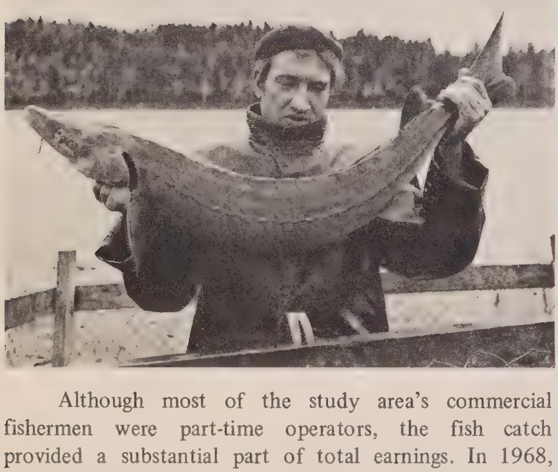
Sturgeon is one of the important minor commercial fish taken by the northern fisherman.

TABLE 16. Estimated earnings derived by Indians from fishing, 1968

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total
Fishing earnings (in thousands of dollars)	136.5	35.0	–	85.0	–	256.5
Fishing as % of basin income	21.0	31.0	–	35.0	–	n.a.
Fishing as % of regional income	9.0	2.3	–	5.5	–	17.0
Average earnings ($)	975	1,000	–	3,400	–	1,283

The main commercial fishing areas coincided with the distribution of most of the region's Indian population as seen by a comparison of Maps 7 and 14.

The components of annual income derived by Indians from commercial fishing, based on commercial fishing licences, are summarized in Table 16.

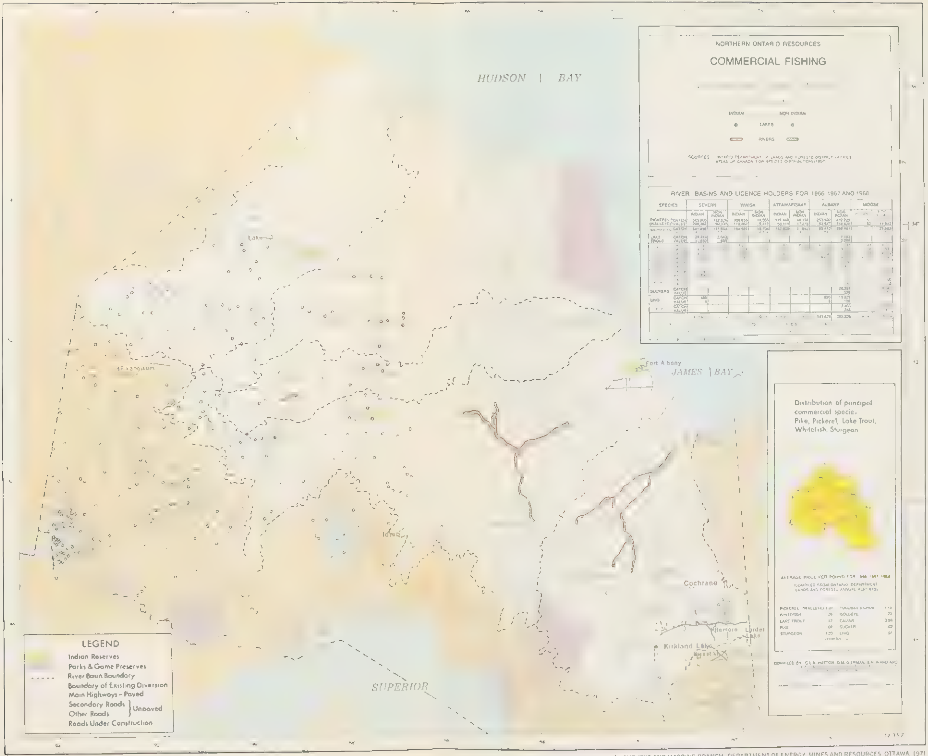


Although most of the study area's commercial fishermen were part-time operators, the fish catch provided a substantial part of total earnings. In 1968, Indians of the Severn basin derived 21 per cent of their annual earned income from fishing; the Winisk Indians, 31 per cent; and the Albany Indians, 35 per cent. Commercial fishing in the Severn basin contributed 9 per cent of regional earnings, and the Winisk contributed 2.3 per cent; earned income derived from the fishery in the Moose basin in 1968 was negligible. A comparison of the cumulative value of the catch, 1966-1968, with 1968 indicated wide annual fluctuations in the catch, and therefore, wide fluctuations in earnings. Average earnings for 1968 ranged from $975 for the Severn fisherman to $3,400 for the Albany fisherman. Fishing records indicated that Indians fishing the Attawapiskat resided outside the basin, but did not specify where.

In most of the study area, volumes of fish catches have been stable; market prices have not. From 1963 to 1968, prices for pickerel and whitefish, the two leading species providing the greatest share of market value, have varied by 52 per cent and 27 per cent respectively. Caviar, sturgeon and lake trout commanded the highest prices per pound and provided the most stable market. Their price fluctuations were comparatively small: caviar, 8 per cent; sturgeon, 18 per cent; and lake trout, 19 per cent. Some of the variability in prices may be attributed to the lack of a regulating marketing mechanism.*

With more intensive management, processing and marketing practices, the productive lakes and rivers of the region may yield greatly expanded catches of freshwater fish, aimed at specialty markets, such as the high-priced restaurant and delicatessen trade. While the economic consequences of greatly expanded activity may be relatively predictable, the environmental consequences are less so.

*The establishment of the Freshwater Fish Marketing Board holds the promise for changed conditions in this respect.



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Agriculture

Agricultural Base

Although agriculture constitutes a comparatively small and decreasing proportion of total economic activity, it is given considerable emphasis in this report primarily because of its substantial influence on land resources in the most populated part of the study area (Hills, 1960). Agriculture is restricted to the Moose basin in an area of podzolic clay soils (Maps 15-17). Although inherent fertility is high, soil drainage is generally poor. Because of the drainage problem and other factors, such as marginal climate and distance from large markets, little of the total area has been developed for agriculture. Summers are too cloudy and wet for dependable ripening of commercial crops, particularly grains.

Estimates of arable land area run as high as 16 million acres, approximately 85 per cent of which is poorly drained, leaving approximately 2.4 million acres with potential for immediate development. Of this amount, only 75,400 acres, or 3.1 per cent, was improved farmland in 1966.* Improved acreage constituted approximately half of the total farm area.

Farming

In 1966 there were 687 farms in the area supporting a total farm population of some 4,880 persons, or about 5 per cent of the population of the Moose basin. About 86 per cent of the farms were operated by their owners; the remainder were operated mainly on a part owner/part tenant basis. In terms of size, 57.4 per cent of the farms were from 130 to 400 acres, 27.2 per cent of the farms exceeded 400 acres and 15.4 per cent were smaller than 130 acres.

In 1966, one-quarter (170) of all farms were classed as commercial farms. The 1966 Census defined a commercial farm as one having sales of farm products of $2,500 or more during the 12-month period prior to the census. A farm with less than $2,500 in sales may be defined as non-commercial, although it may in fact contribute substantially to total income and to subsistence living; three-quarters of the farms in the area were in the non-commercial category. Of the 170 commercial farms, 44 per cent were in each of the $2,500 to $5,000 and $5,000 to $15,000 ranges. Only 12 per cent exceeded $15,000 in the sale of farm products.

The dominant types of farming in the study area are shown on Maps 15 and 16. Dairy farms constituted over one-half of all commercial farms; other types of livestock and poultry constituted about one-third. Pasture amounted to 39 per cent of improved land, and the acreage under crop, about 61 per cent; in contrast with Ontario averages in which pasture occupied about 24 per cent of improved land and the acreage under crop, about 70 per cent. More pertinent to agriculture was that about 80 per cent of the entire field-crop acreage was devoted to cultivated hays, with a further 14 per cent to oats for use as cattle fodder. The basic dependence on pasture and on hays emphasizes the climatic limitations and importance of livestock.

From 1961 to 1966, the number of farms decreased by 24 per cent, compared with 9 per cent for all Ontario. Total farm area of the Clay Belt decreased by 13 per cent and crop area by 15 per cent. The number of commercial farms was reduced by 16 per cent; whereas, through farm consolidation, the number of farms over 400 acres in size had increased in number (Map 16).

TABLE 17. Comparison of the main components of agricultural sales

	% of total value of sales		Amount of change, 1961 to 1966, as a proportion (%) of 1961 values
	1951	1966	
Dairy products	39	48	−12
Cattle	23	26	+34
Eggs	11	9	−5
Hay and fodder	12	5	+6
Potatoes	2	4	−17
Pigs	6	2	−3
Other	7	6	–
Total (%)	100	100	–

*Preliminary data from the 1966 Census gave a figure of 74,895 acres of improved land, Map 17; final tabulations for the area were 75,441 acres. Similarly, the preliminary data on value of all farm products sold exceeded $1.7 million; final tabulations showed sales in excess of $1.9 million.

A dairy farm in the Clay Belt.
Credit—K. Taylor, Lands Directorate

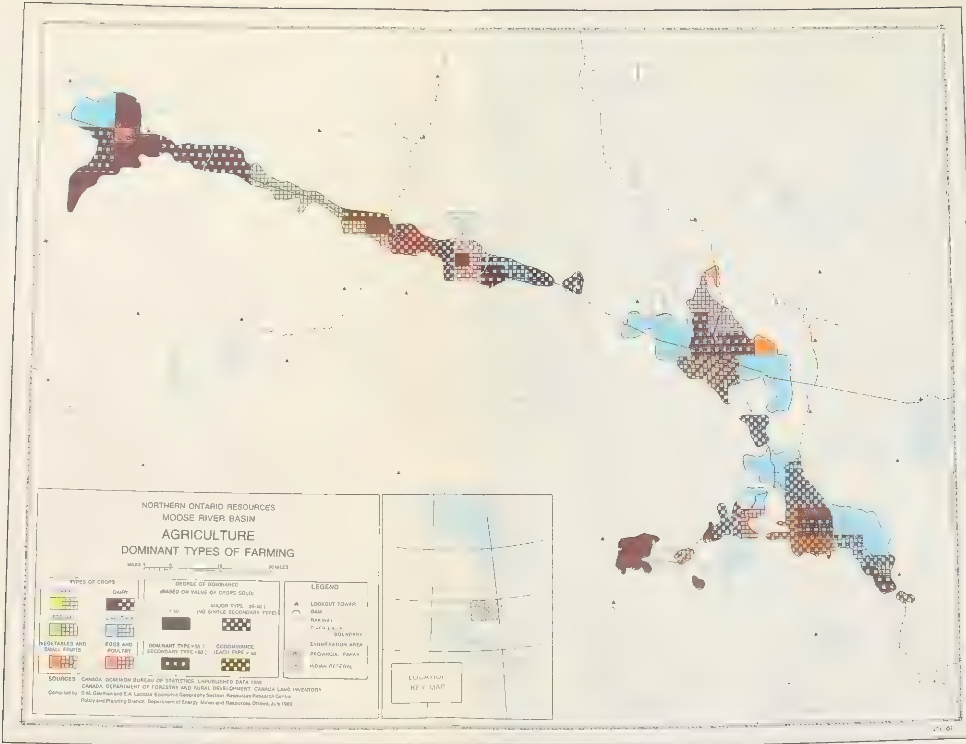
The total value of farm products sold (1966 Census) amounted to about $1.9 million. Dairy products accounted for about one-half, and cattle, one-quarter, of agricultural sales of farm products.

Table 17 outlines the components that were most significant for the census years 1951, 1961 and 1966.

Forest products, not listed in Table 17, provided an important supplementary source of farm income. In 1966 they accounted for 9 per cent of gross sales of farm produce and were exceeded in order of value only by dairy products and cattle.

Agricultural Trends

Agricultural trends in the region were toward decreased total farm acreage, improved quality of fodder crops, increased mechanization, and greater use of fertilizers. Beef production showed marked signs of expansion (+34%) and was accompanied by an increased production of hay and fodder (+6%). The marked decline in potato production (−17%) indicates that the area is at a distinct disadvantage to more favourably located growers closer to the large urban markets in the south. Most livestock is shipped out of the area, so that there is little local finishing and processing of beef. A further reflection of the instability of agriculture in the region is that much agricultural produce, such as fresh fruit, vegetables and processed meat, is obtained from outside the Clay Belt; also, agricultural workers accounted for only 2 per cent of the Moose basin labour force, compared with almost 9 per cent for Ontario. In terms of agricultural productivity ("Regional Comparisons of Agricultural Productivity" table, Map 17), the area has a marked disadvantage when compared with the rest of Ontario: productivity per improved acre was $22.89 compared with $84.76 for Ontario, but it surpassed the Peace River region, where farms tend to be larger, at $17.35. However, productivity by census farm, in terms of the sale of farm products, was $2,496 in contrast with $9,259 for Ontario and $5,934 for the Peace River. The low average value of farm output scarcely met census requirements in 1966 for the Clay Belt to be classed as a commercial agriculture region.



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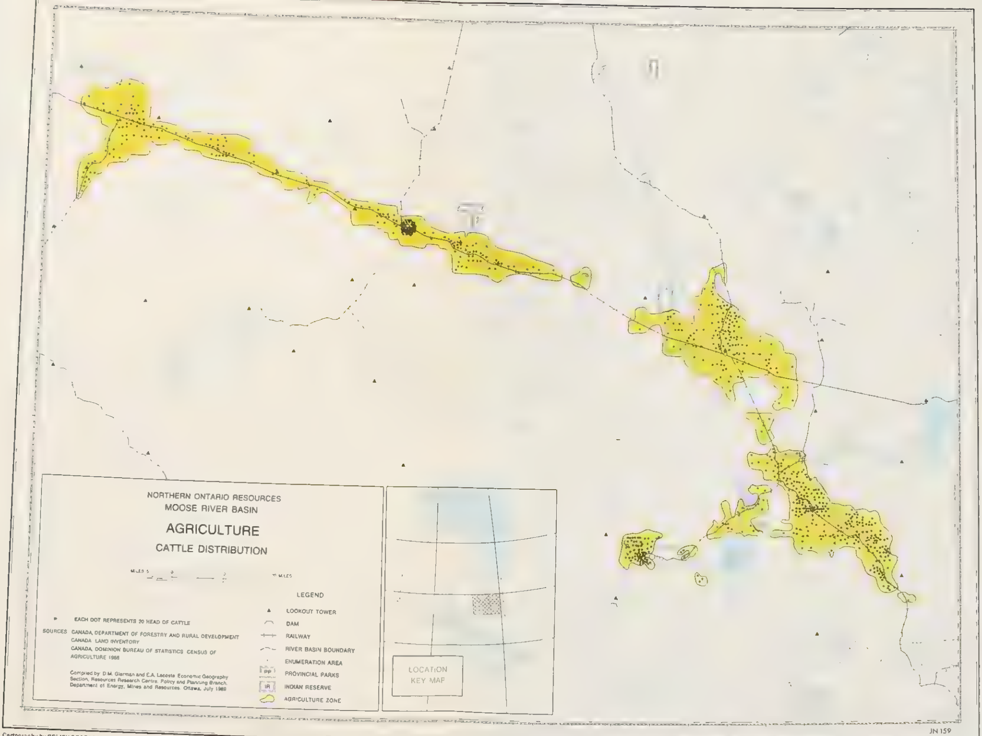

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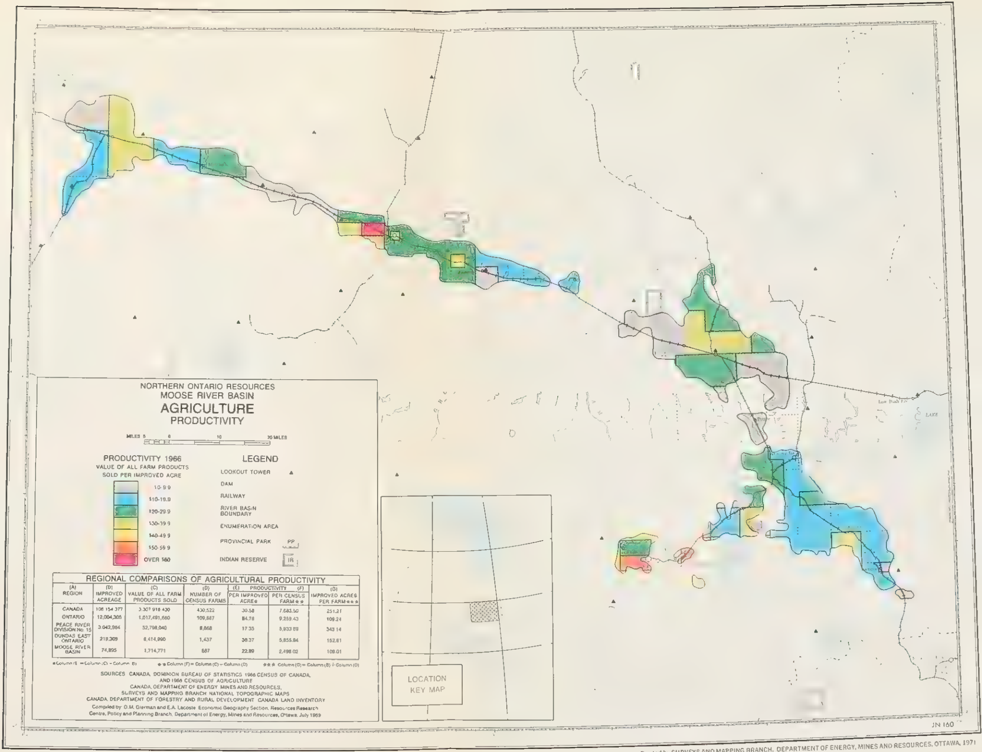

REGIONAL COMPARISONS OF AGRICULTURAL PRODUCTIVITY

(A) REGION	(B) IMPROVED ACREAGE	(C) VALUE OF ALL FARM PRODUCTS SOLD	(D) NUMBER OF CENSUS FARMS	(E) PRODUCTIVITY PER IMPROVED ACRE*	(F) PRODUCTIVITY PER CENSUS FARM**	(G) IMPROVED ACRES PER FARM***
CANADA	108 154 377	3,307 918 430	430,522	30.58	7,683.50	251.21
ONTARIO	12,004,306	1,017,491,660	109,887	84.76	9,259.43	109.24
PEACE RIVER DIVISION No. 15	3,042,984	52,798,040	8,868	17.35	5,933.89	343.14
DUNDAS EAST ONTARIO	219,309	8,414,990	1,437	38.37	5,855.84	152.61
MOOSE RIVER BASIN	74,895	1,714,771	687	22.89	2,498.02	109.01

*Column (E) = Column (C) ÷ Column (B)   ** Column (F) = Column (C) ÷ Column (D)   *** Column (G) = Column (B) ÷ Column (D)

SOURCES CANADA, DOMINION BUREAU OF STATISTICS 1966 CENSUS OF CANADA, AND 1966 CENSUS OF AGRICULTURE
CANADA, DEPARTMENT OF ENERGY, MINES AND RESOURCES, SURVEYS AND MAPPING BRANCH NATIONAL TOPOGRAPHIC MAPS
CANADA DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT CANADA LAND INVENTORY

Compiled by: D.M. Gierman and E.A. Lacoste Economic Geography Section, Resources Research Centre, Policy and Planning Branch, Department of Energy, Mines and Resources, Ottawa, July 1969

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Recreation and tourism

Patterns of Recreational Distribution

The wilderness environment of northern Ontario is highly desirable for certain types of outdoor recreation which, with associated activities, constitute a significant sector of the northern economy. Of the total number of service-industry employees in northern Ontario, almost two-thirds (63%) were engaged in activities directly related to recreation and tourism: these activities contributed $50,500,000 to the regional economy (Ontario, 1966a). In the northeastern region,* for example, the service industry accounted for 22 per cent of the total labour force. Moreover, travellers from the United States made up a large proportion of the number of visitors of the northeastern region. About 36 per cent of the provincial park campsites were used by American visitors, while in the northwestern region, the corresponding proportion was 45 per cent. It is difficult to estimate the value of recreation in the Ontario arctic watershed, as data were not readily available in the northwestern region.

On the two "Recreation" maps (Maps 18 and 19) showing "Facilities Privately Owned and Facilities Publicly Owned" two aspects of distribution are immediately apparent: first, the southern part of the study area is much more developed than the northern and western parts, and secondly, comparatively few of northern Ontario's developed recreation facilities lie within the study area. The penetration of recreational development into northern areas has just begun.

The distribution of accommodation facilities across northern Ontario may also be compared with that of the study area. In 1968, throughout the whole of northern Ontario, there were 14,050 accommodation units: cottages, motel units and other rented rooms (Ontario, 1968f). Of these, only 2,954 units, or 21 per cent, were located in the study area. Distribution among the five basins was as follows (Table 18).

TABLE 18. Distribution of accommodation units, 1968

Severn	18
Winisk	16
Attawapiskat	34
Albany	528
Moose	2,358
Regional total	2,954

The most notable aspects of this distribution pattern were the concentration of accommodation facilities in the southern Moose basin and an almost complete lack in the most northern areas. In the Moose basin it accounted for one-tenth of all occupations.

The main factors affecting this distribution were those which also influenced the distribution of publicly owned facilities: as population and accessibility decreased significantly northward, demand for accommodation decreased accordingly. Recreation and tourism in northern Ontario were directly dependent on the transportation system (see Map 22). This map, together with the "Recreation" maps (Maps 18 and 19) should prove useful in providing information on the general distribution of other unspecified, privately owned recreational facilities, such as marinas.

Summer camping was a major recreational activity (Ontario, 1968b). There were approximately 3,200 provincially operated campsites in all of northern Ontario: of these, only 650, or 20 per cent, were located within the study area. The average length of stay was about 1.5 days. The campsites remained open for approximately 100 days; periods of peak demand occurred during July and August, with average occupancy rates of 47 per cent. No data were available on expenditures made by campers either in the study area, or in northern Ontario.

Hunting became the predominant recreational activity in the autumn. The main species hunted included bear, moose, deer, duck, geese and grouse. Since the exploitation of these wildlife resources is largely dependent on privately owned camps and outfitters, the distribution of these game species is indicated on Map 18 in a number of insets showing "Distribution of Main Animals Hunted for Recreation." Limited data were available concerning expenditures made by hunters: in the Swastika-Kirkland Lake area, for example, 42 non-resident hunters spent from $20 to $150 per man, with an average of $95 (Ontario, 1966a).

*Northeastern region as defined by the Department of Economics and Development, Applied Economics Branch, Ontario. See: Ontario, 1966a – Northeastern Ontario Region Economic Survey.

Hunters arrive in the autumn at a permanent goose hunters' camp in Moosonee.

Although the winter climate is considered severe for outdoor recreational pursuits by many southerners, and although facilities for winter sports are comparatively limited, winter activities are increasing. This trend has been particularly evident since the introduction, and rapid spread, of the small, personal snowmobile, which has extended considerably both the area and the time period available for hunting.

Characteristics of Northern Recreation

Recreation in northern Ontario and in the study area is based primarily on the characteristics of the wilderness environment. In spring and summer, the major recreational activity is sport fishing. The lakes and rivers of the area are noted for the abundance of game fish; many specimens are of trophy size. Principal species include lake trout, pickerel, northern pike, and bass. While no data on the economic returns, either for the study area or for the entire northern Ontario region, are available, the importance of recreational fishing is made clear by the fact that many accommodation establishments cater directly to anglers by providing boats, motors, tackle and guiding services.

In areas inaccessible by road, a number of fly-in fishing, hunting and outfitting camps have been established in the recent past. These camps depend on accessibility by air. These were developed in response to increasing levels of disposable income, urban and environmental deterioration, overcrowding in more accessible recreation areas, and particularly, in response to the experience gained by holidaying in the solitude of the northern wilderness. The mega-urban areas, particularly in southern Ontario, Quebec and the northeastern United States, which together exceed 100 million people, can be expected to generate considerably more "fly-in" traffic. Most of the fly-in camps and, indeed, many of the camps in the southern sections of the study area, employ local Indian guides – a practice that has contributed substantially to the income of many northern residents. Estimated income of Indians from tourist guiding activities has been summarized in Table 19.

Table 19 indicates that Indians' guiding income ($51,600) amounted to 3.4 per cent of the region's total earned income. Not all Indian groups had equal access to the tourist's dollar; relatively few were beneficiaries of the industry. Although the contribution from guiding seemed small in relation to total regional economic activity, it constituted a significant amount of total earned income for some Indian groups.

TABLE 19. Estimated earnings derived by Indians from guiding, 1968

	Severn	Winisk	Attawapiskat	Albany	Moose	Regional total
Guiding earnings (in thousands of dollars)	21.0	3.3	2.0	15.0	10.3	51.6
Guiding as % of basin income	3.0	3.0	9.0	6.0	2.0	n.a.
Guiding as % of regional income	1.4	0.2	0.1	1.0	0.7	3.4
Average earnings ($)	149	330	200	333	294	214

The Ekwan River forms the southern boundary of Polar Bear Park; the park is on the far side of the river.
Credit—Geological Survey of Canada

Aircraft equipped with pontoons, wheels or skis provide an indispensable means of travel in the region. Near the forks of the Kenogami River simple docking facilities are easily available.
Credit—Geological Survey of Canada

Provincial Parks

Provincial parks occupied 9,060 square miles in northern Ontario, including approximately 7,000 square miles recently set aside for Polar Bear Park and the Winisk Wild River Park in the northern parts of the study area.* No statistics were available on their use. Of the remaining 2,060 square miles, only 245, or about 12 per cent, lay within the study area. Of these 245 square miles, 215 (88%) were within the Moose basin and the other 30 square miles in the Albany. Neither the Attawapiskat nor the Severn basins contained provincial parks. Since most of the study area was sparsely populated and inaccessible by road, most land set aside for parks has been reserved for purposes of conserving wildlife and wild landscape rather than for human recreational activity as in the south. Many proposals have been made to set aside stretches of northern rivers as wild river parks and preserves: among the most extensive are proposals to set aside reaches of the Severn and of the upper Winisk and Attawapiskat as shown on Map 19, "Recreation—Facilities Publicly Owned."

Trends in Northern Recreational Development

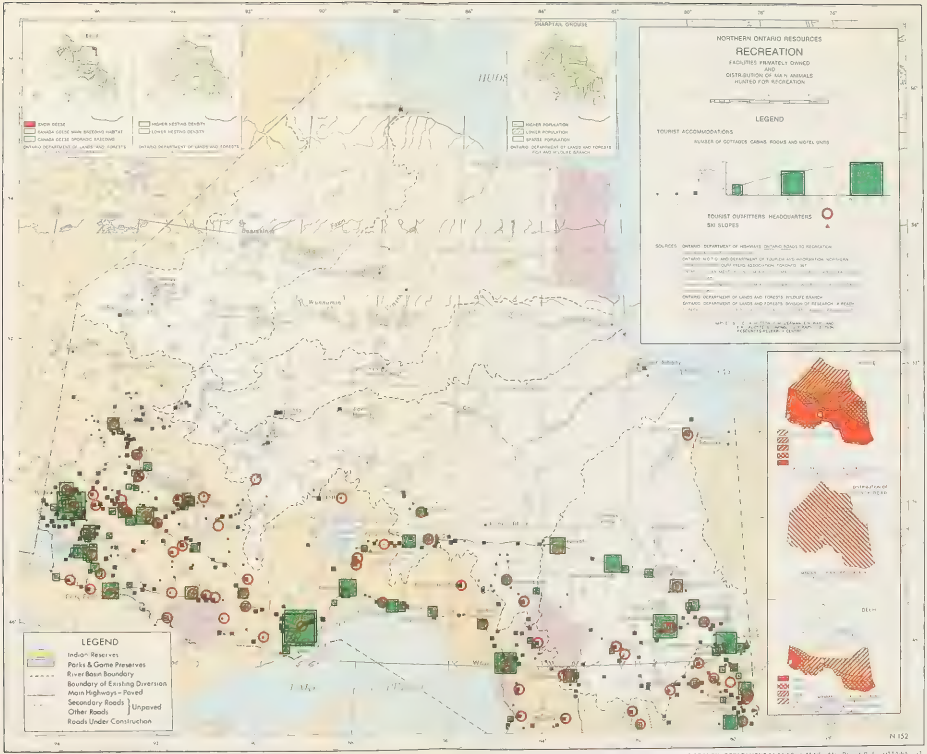
Recreation in the study area is based squarely upon the high quality of the wilderness environment. As elsewhere, many of the activities are water based, or are dependent on lakes and waterways for accessibility or upon clean unpolluted water. Probably the most influential factor affecting the distribution of recreational facilities is the road system. Comparatively little recreational activity occurs in areas more than 25 miles from roads. The expansion of the road network would extend the recreation potential, particularly to those areas of the basins that lie in the Shield. "Fly-in" camps at remote locations are becoming increasingly popular.

The importance of the economic impact of recreation and tourism was mentioned at the outset of this section. The Ontario Economic Council (1965) has estimated that for the entire province, each dollar spent by a "foreign" visitor on food, lodging, guiding, hand-

*Since 1968, the boundaries of Polar Bear Park have undergone substantial revision.

crafts, etc. had a total impact of $3.50. No comparable multiplier estimate is available, either for northern Ontario or for the study area, but even assuming that the value is smaller, it appeared that the large proportion of American visitors had a significant effect on the regional economy. In addition, cottage owners contributed a significant amount to the tax receipts of the region while making minimum demands on welfare and education facilities. Against this, however, must be balanced public expenditures on roads and other infrastructure and the environmental impact of recreational activities.

There can be little doubt that more of the north will experience recreational development. Recreation has become a dynamic growth industry and is firmly established in much of the north. Increased recreational demands will be generated in response to factors such as rapidly increasing population, urban crowding, increased leisure time and disposable incomes. As recreational development progresses, it will probably follow the extension of primary roads opened by mining and forest industries and, possibly later, by municipalities, as they undertake to provide increased accessibility to recreational resources.



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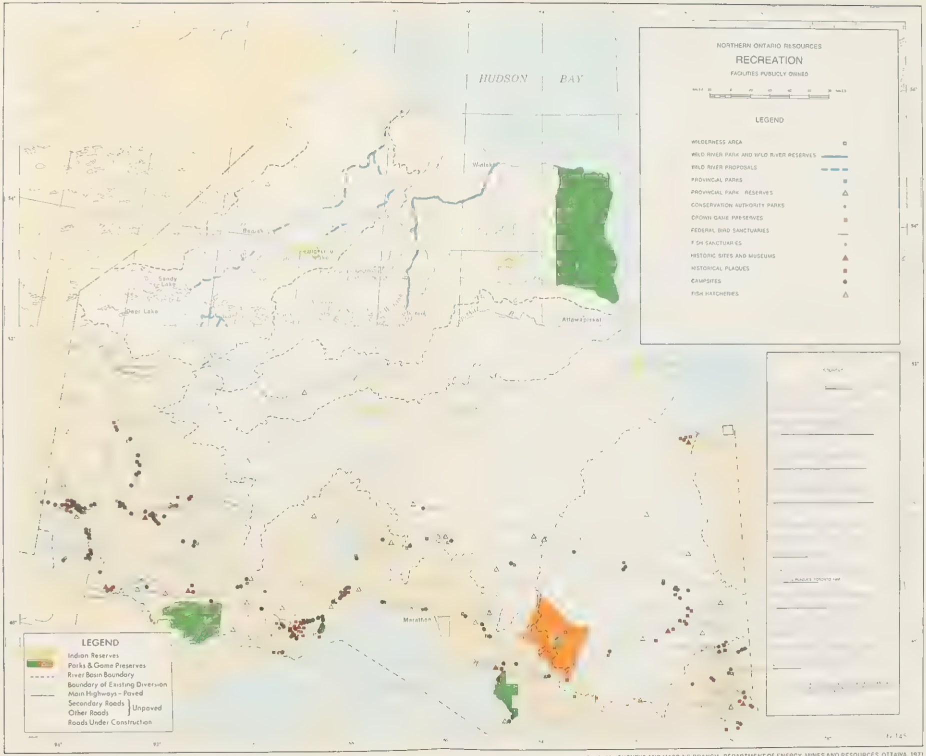

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Electric power

Abitibi Canyon generating station.
Credit—Ontario Hydro

Development of Hydro-electric Power Generation

All hydro-electric generating stations of the Ontario arctic watershed are located in the Moose basin. The earliest stations were developed by the mining and paper companies to provide power for their operations.

The Hydro-Electric Power Commission of Ontario (HEPCO) units for the Timmins-Porcupine gold mining area were constructed and installed at Sandy Falls, Wawaitin Falls and Lower Sturgeon Lake on the Mattagami River from 1911 to 1923. The growth and expansion of the Abitibi Power and Paper Company Limited (APPC) and the Spruce Falls Power and Paper Company Limited (SFPPC) resulted in a development of power sites to provide power for industrial mills and company towns in the 1920's: hydro-electric stations were completed at Smooth Rock Falls in 1916 and at Smoky Falls in 1928 on the Mattagami River; at Kapuskasing Station in 1923 on the Kapuskasing River; at Twin Falls in 1921 and at Island Falls in 1924 on the Abitibi River. Expansion of the SFPPC operations at Kapuskasing resulted in the completion in 1928 of the only large thermal plant (22,900 kilowatts) in the region; it was fired by coal, natural gas and wood wastes.

In the period from 1930 to 1960 the most significant increase in power was the completion in 1959 by HEPCO of the Abitibi Canyon site with a total capacity of 210,075 kilowatts—the largest station in the Moose basin. In the same period, APPC completed in 1949 the 21,485 kilowatt plant at Iroquois Falls.

The largest expansion in hydro-electric power generation occurred in the 1960's: recent advances in extra high-voltage, long-distance transmission techniques have provided impetus for the development of hydro-power sites previously considered too remote. Between 1961 and 1966, four stations, each of more than 120,000 kilowatts capacity, were constructed: the Harmon, Kipling and Little Long stations on the Mattagami River and the Otter Rapids station on the Abitibi River, with a combined capacity of 551,000 kilowatts. Each had provision for installation of further units, which would allow the initial capacity to be doubled. All four stations were controlled

from the Pinard transformer station near Abitibi Canyon, from where most of the output of all four stations was transmitted 435 miles south to Toronto via a 500-kilovolt line. Each of these stations operated at 50 to 60 per cent capacity, while the 10 other stations operated at approximately 80 per cent. By 1968 hydro developments in other areas and proposals for extensions to three existing stations on the lower Mattagami River were being considered.

Power Generation

Power-generating facilities with capacities in excess of 1,500 kilowatts and the power transmission lines are shown on Map 20. Table 20 shows that Ontario Hydro in 1967 owned 82.6 per cent of all generated power.

All hydro-electric generating stations of the Ontario arctic watershed were located in the Moose basin, as summarized in Table 21. The Kapuskasing thermal station is not included.

TABLE 20. Ownership of developed power capacity, 1967
(Expressed as percentage of total capacity: 924,655 kilowatts)

River	Ontario Hydro (HEPCO)	Private (APPC, SFPPC)	Total
Abitibi	82.8	17.2	100
Mattagami	87.1	12.9	100
Kapuskasing	–	100	100
Total (%)	82.6	17.4	100

TABLE 21. Hydro-electric generation in the Moose basin, 1967

	Developed hydro sites		Undeveloped hydro sites	
River	No. of sites	Total capacity (kW)	No. of sites	Potential capacity (kW)
Abitibi	5	465,010	2	142,351
Kapuskasing	1	2,750	–	–
Mattagami	8	456,895	2	100,570
Missinaibi	–	–	4	132,762
Moose	–	–	2	228,424
Total	14	924,655	10	604,107

The 14 developed sites had an installed capacity of 924,655 kilowatts. Although annual capacity of all hydro-generating stations in the Moose basin was about 8.1 billion kilowatt hours,* or 54,000 kilowatt hours per capita, actual output in 1967 was 5.5 billion kilowatt hours or 68 per cent capacity. The total value of this power at source was about $10.5 million. In addition to the developed sites there were 10 undeveloped sites, which had a potential capacity of 604,107 kilowatts. Development of these generally less economic sites would increase the 1967-1968 hydro-power capacity of the Moose basin by about two-thirds.

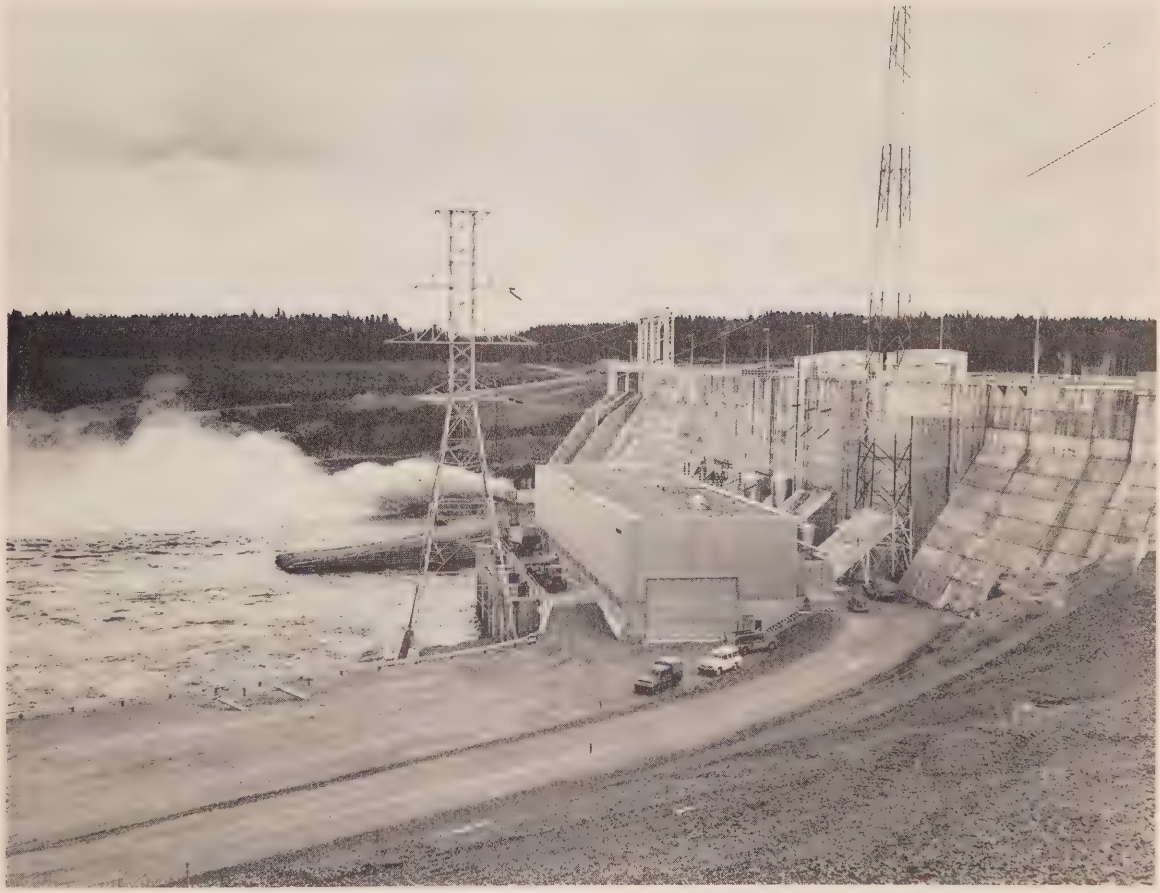
There were three minor undeveloped sites in the Albany basin at Eskakwa Falls, Kagiami Falls and Martin Falls, respectively; estimated total capacity, however, was only 36 kilowatts. Six other sites in the Severn, Winisk and Attawapiskat basins were not shown on Map 20, since their potentials were unknown.

Consumption and Distribution of Power

It has been noted that the earlier hydro-power generation units were privately owned and unconnected units: each served local markets that were dependent upon a single source of power. The integration of independent power sources, mainly through HEPCO, has provided an extensive and interconnecting transmission system assuring a continuity of power from a diversity of sources (Map 20). In 1968, Ontario Hydro generating plants served nine municipalities in the Moose basin, primarily for domestic purposes: Cochrane, Gogama, Hearst, Kapuskasing, Matheson, McGarry Township, South Porcupine and Timmins-Schumacher. In that year the municipality consumed 196.3 million kilowatt hours. In comparison, the two paper companies consumed 1.1 billion kilowatt hours or about 5.6 times as much as the total domestic consumption. Total consumption of electrical energy in the Moose basin was therefore about 1.3 billion kilowatt hours or 23 per cent of total output. The other 77 per cent was consumed outside the basin, mainly

*Annual capacity = 924,655 kilowatts x 24 hours/day x 365 days per year =8.1 billion kilowatt hours.

Harmon generating station.
Credit—Ontario Hydro



in southern Ontario. The combined capacity of 551,000 kilowatts from Harmon, Kipling and Little Long stations on the Mattagami River and Otter Rapids station on the Abitibi River was transmitted 435 miles south to Toronto over a 500-kilovolt line. Each of these stations operated at 50 to 60 per cent capacity. Most of the Abitibi Canyon plant output was transmitted to Sudbury over low-voltage lines.

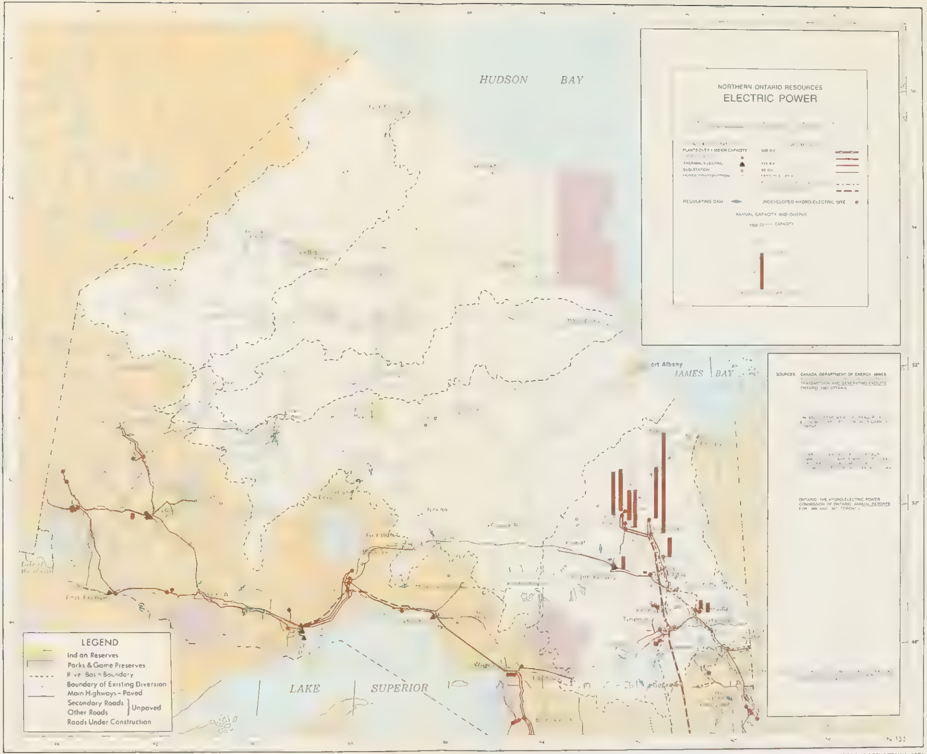
The Northern Canada Power Commission supplied electricity to Moose Factory from a coal-burning plant and a diesel plant with respective capacities of 200 and 650 kilowatts. The towns of Armstrong, Sultan and Moosonee were served by diesel plants with respective capacities of 200, 250 and 425 kilowatts. Many small isolated groups of people, scattered throughout the region, have no electricity; they are largely dependent on portable generators or wood for fuel and kerosene for lighting.

Comparatively little electrical energy was supplied from outside the study area, except to the consumers in the upper Albany and Attawapiskat basins; consumption of "imported" power is shown in Table 22.

TABLE 22. Consumption of imported power in the Ontario arctic watershed, 1968

Locality/Municipality	Basin	Power consumption (kWh)
Chapleau Township	Moose	9,033,000
Geraldton and Hornepayne	Albany	15,610,000
Pickle Lake ,	Attawapiskat	1,408,000
Total "imported" power		26,051,000

Most sites in the study region suitable for economical hydro-electric power generation have now been developed. Although several undeveloped sites have potential, they are limited in comparison to the capacity of existing power plants, and development costs are higher. Consequently, although hydro power will continue to satisfy a major part of provincial electric energy demands, other sources, such as thermal and nuclear plants, have been receiving increased attention, notably the extensive low-grade lignite coal deposits at Onakawana in the Moose basin. It was estimated that the deposits could support a potential on-site 1,000-megawatt thermal-electric generating station (Canadian Press, 1974). In the study region, the primary users will continue for some time to be the mining and forest industries.



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Transportation and communications

Historic Patterns of Transportation

In the Ontario arctic watershed, waterways provided the historic means of transportation. Following the formation of the Hudson's Bay Company in 1670, fur-trading posts were established around the coastline at the mouths of large rivers (Map 21) (Voorhis, 1930). The most important post in the region was Fort Albany,* founded in 1683, a year after the founding of York Factory (Fort Nelson) at the mouth of the Hayes River. Henley House, the first interior post, was built in 1741, 150 miles up the Albany River, to prevent encroachments by French fur-traders. Fort Moose or Moose Factory on the Moose River was founded by Radisson and Groseilliers in 1671; shortly after it was occupied by the Hudson's Bay Company. Fort Abitibi at the east end of Lake Abitibi and built by De Troyes in 1686 was the most advanced station of the French fur-traders from Montreal. It was occupied by the Hudson's Bay Company prior to 1774 and became an important outpost of Moose Factory after 1783. The second Fort Abitibi, located near the west end of the lake, was built by French fur-traders before 1688. It was taken over by the North West Company about 1783 and was operated by this company until the union of the two companies in 1821. The "Bay" had succeeded in drawing the trade of the Indians of the whole upper lakes region to their posts; the economic value of the region to the "Bay" was almost entirely as a source of furs.

Prior to 1750 the shallow-draft York boat was introduced by the Hudson's Bay Company factor at Fort Albany to replace the birchbark canoe. The broad waterways of the Albany system provided continuous and relatively easy routes to Lake Superior and the waterways of the West. By the end of the 18th century, competition from Montreal traders had forced the Albany men to travel great distances in their York boats. Posts were established on the headwater lakes of the waterways, and at the century's end they were pushing across the waterways of the prairies. This exploration program to develop the fur resources enormously enriched Fort Albany's fur returns. The economic advantage of the Albany waterway routes was undoubtedly a major factor in the ultimate success of the "Bay" in dominating all of its rivals in the fur trade and in staking out in its name a large piece of the continent.

*Fort Albany was the only fort in the Hudson Bay region held by the Hudson's Bay Company from the Treaty of Ryswick (1697) to the Treaty of Utrecht (1713).

The York boat, built locally at lonely posts scattered throughout the wilderness, was peculiar to the fur-trade operations of the Hudson's Bay Company (Black, 1968). Although it had striking advantages over the freighter canoe, it was not adopted by the North West Company. When the companies united in 1821 the York was substituted for the freighter canoe throughout the Company's extensive service. Fort Albany, the centre for the Company's thrust across a continent, failed to develop: Norway House in Manitoba, founded in 1814 on Little Playgreen Lake as a strategic centre from which the Company's boat transportation across half a continent could be controlled, replaced Fort Albany.

Before the coming of the railways, the rivers were the major arteries of transportation and communication; the York and the birchbark canoe were the prime means of transport, and fur trapping, the principal industry. The Albany River system with Fort Albany at its mouth was still the main focal point; Fort Albany had outlived many outposts erected to serve the fur trade over the years. The completion of the CPR line through the southwest corner of the region and along the north shore of Lake Superior introduced the railway era (1884-85). The completion of the National Transcontinental Railway by 1913 across the headwaters of the Abitibi and Albany rivers and the Clay Belt–from Kirkland Lake through Cochrane, Hearst and Nakina–brought an end to the fur brigades on this and other rivers. The shipping of furs to Moose Factory by canoe was discontinued; henceforth, furs were shipped out by rail to Montreal. Earlier, in 1911, the Canadian Northern Railway was completed; the line traversed a region from Gogama to Nakina between the CPR to the south and the National Transcontinental to the north.

The railways through northern Ontario had profound effects (Dean, 1957). Agricultural settlers moved in to occupy the newly discovered Clay Belt; pulp and paper companies and sawmilling outfits were established where the railways crossed major rivers. Fort Albany declined as a focus of Indian settlement and Pagwa River on the railway line grew as a new centre. The railway drew numbers of Indians into settlements along the right-of-way and opened

The *Albany*, one of the largest and most powerful riverboats to operate on the Albany River, was built to assist in handling the fleets of scows which were run downstream during the high water in the spring from Pagwa. The scows, loaded with supplies, were broken up for building purposes downriver.
Credit—Geological Survey of Canada

up opportunities and activities for them. The Algoma Central, completed in 1913 between Sault Ste. Marie and Hearst, was built to make the Clay Belt more accessible to settlers and to tap the mineral and forest resources of the region. The completion of the Ontario Northland Railway from Temiskaming to Moosonee in 1932, to open new mineral and forest resources and to give Ontario direct access by rail to James and Hudson bays, marked the end of the railway era (Map 22). These forces brought the white man's culture into contact with Indian culture and changed the economy of the region. The fur economy, which had been dominant for about three centuries, was dramatically replaced by the extractive-resource economy of the 20th century.

An important section of the Albany waterways continued in use. In 1916, Revillon Frères trading company founded a post at Pagwa River on the railway to serve several of their posts downstream and at the mouth of the Albany River. From Pagwa River the company sent as many as 40 scows in a brigade downstream on the spring flood. The scows loaded with supplies were launched in May to drift down the Pagwachuan, Kenogami and Albany rivers; at their destination the scows were broken up for their lumber. Smaller brigades operated on other tributaries of the Albany.

Powerful tugs operating on long chains of lakes in the Shield in recent years were mainly restricted to the towing of log booms, the hauling of lumber and railway ties, the transportation of ore and the towing of scows. After the building of the Ontario Northland Railway in 1932, the number of scows on the Albany was reduced. The development of aircraft freighting to Ogoki brought an end to the scow brigade on the Albany between Ogoki and its confluence with the Kenogami River; the closure of English River Post ended the brigade on the Kenogami River.

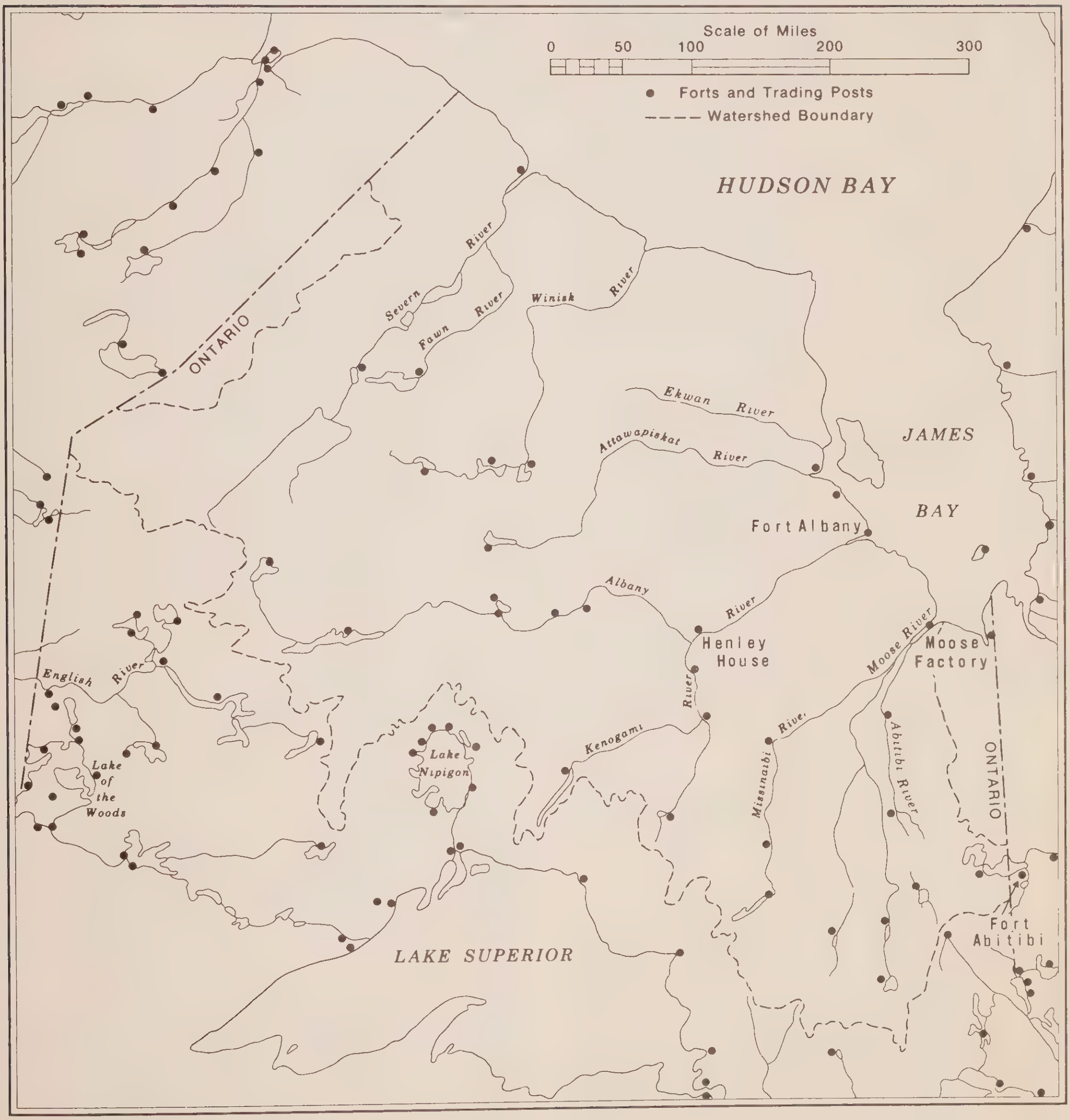
In the late 1920's the tractor-train, an important form of winter transport, proved effective in moving large quantities of supplies and heavy equipment in the north. Moreover, the frozen surfaces of lakes and rivers and winter roads opened by the mining and logging companies could be used.

The old and the new in northern communications.

The Hudson's Bay Company's trading post at Moose Factory in the 1880's; the post was established on this site in 1713.
Credit—Geological Survey of Canada

Map 21. Historic forts and trading posts

Source: Voorhis. 1930



In recent years a new element has appeared in water transportation; namely, the outboard-powered, light, shallow-draft boat. Capable of ascending rapids and traversing water at speeds unmatched by the canoe and river boat, it has become the ubiquitous boat of today.

Navigability of the Waterways

Navigation on many lakes and rivers, while often limited to relatively short distances, remained important to individual communities, to industry, and to Indian bands. The coastal points on James and Hudson bays, such as Fort Albany, Attawapiskat, Winisk and Fort Severn, are served by small cargo ships from the end of the railway at Moosonee.

TABLE 23. Navigable rivers of the Ontario arctic watershed

River / Tributary	Navigable distance (miles)	Upstream navigation limit to first major obstacle
Severn	47	to Limestone Rapids
	147	to confluence with Witegoo River
Winisk	40	to rapids
	200	to confluence with Asheweig and Winiskisis rivers
Attawapiskat	330	Attawapiskat Lake
Albany	250	Martin Falls
Kenogami	93	above confluence of Pagwachuan River
	120	to 19th portage on Kenogami River
Pagwachuan	50	Pagwa River
Ogoki	40	Eby Falls, above confluence of Colpitts Creek
Moose	70	Confluence of Missinaibi and Mattagami rivers
Missinaibi	125	Long Rapids
Opazatika	25	Breakneck Falls
Mattagami	90	to dam below the Long Rapids
Abitibi	65	to the Long Rapids

Only in high-water periods, following the spring break-up, are the major rivers navigable for any great distance beyond their mouths; long navigable reaches may be broken by short rapids and fast chutes. The navigability of the rivers may vary considerably from year to year depending on the timing of break-up, accumulated winter's snowfall and upon prolonged spring rains. Table 23 provides a list of rivers navigable for boats of 2- to 2½-foot draught at high water* (Map 22) (Black, 1968).

Railways, Highways, Air Lines and Communications

Railways served the southern part of the Moose basin and the southeastern part of the Albany basin; all of the larger communities have railway connections (Map 22). The main railways serving this area were the Canadian National, the Ontario Northland, and the Algoma Central and Hudson Bay railway. The Canadian Pacific served only one community in the study area, Chapleau. The north-south lines were the most heavily travelled. Moosonee was served by the Ontario Northland from Cochrane whence goods for coastal communities were trans-shipped to boats. Tourist excursion trains were operated between Cochrane and Moosonee during the summer months. A 16-mile spur, completed in 1966, was extended to the Texasgulf copper-zinc-silver mine near Timmins. In addition, the natural gas pipeline from Alberta passed through the Clay Belt. Since roads served most of the same area as the railways, the latter have become primarily transporters of heavy and bulk freight. Most of the products carried on the two north-south lines, the Ontario Northland and the Algoma Central railways, were pulp and paper, mine products, and supplies for northern communities. In terms of freight, the north-south lines were the most heavily travelled.

Roads in the region, beginning with the opening of mines, lumber camps and the farm areas of the Clay Belt, were classed as dirt or wagon roads. Gradually the nearest towns were connected and the increasing use of cars and trucks brought about improved gravel roads. A more recent development was the building of an all-weather, paved highway network. The Trans-Canada Highway, which parallels the old "National Transcontinental," became the longest

*The navigable distances that are given in Table 23 are not necessarily in disagreement with the navigable waterways shown in Map 22. They do emphasize however, the different standards by which "navigability" can be defined. The York crews used waterways that a tug crew would hesitate to use; moreover, these earlier crews possessed a knowledge of river conditions that few, if any, "rivermen" possess today. The use of rivers that were on the borderline of navigability varied considerably from year to year. The map represents a more conservative estimate of navigability of the waterways.

all-paved highway in the region. The second important group located in the southern Moose basin.

Though the highway pattern is generally loosely knit, and good roads reach most communities, much of the highway development took place in the 5 years prior to 1968. Most communities served by road were also served by at least one trucking firm. Few roads extended north of the Trans-Canada highway. The most important extensions were: Smooth Rock Falls to Fraserdale; Geraldton to Melchett Lake via Nakina; and Ignace (west of Thunder Bay) to Otoskwin River via Savant Lake and Central Patricia. A proposal has been made to loop the Ignace-Otoskwin River road to the north and west and to join it with a road from Red Lake near Cochenour. From this road a branch would extend north to Lingman Lake near the Manitoba boundary. There were also several thousand miles of logging and "bush" roads maintained by the Department of Lands and Forests (Ontario) and by private companies that provided accessibility to logging areas, lookout towers, power sites and mines. Most of these roads, located in the southern parts of the region, tap new forest, recreational or mineral resources. The highway network has steadily extended the range of accessibility in the region initiated by the railways.

In the remote and sparsely populated parts of the region, air services provided the main connection with the outside world. Beginning in the 1920's, aircraft began to play an important role in the exploration and development of the natural resources of the region; moreover, to take advantage of the airmail service the Post Office began to open postal services in the more remote communities. Prior to this time, coastal and interior settlements usually received mail once a year when the Hudson's Bay Company vessel arrived in summer; mail and supplies for interior posts were dispatched by boat.

In 1932 a new phase of transportation development began in the region. The Department of National Defence began the building of a number of airfields and emergency landing strips to meet the requirements of aircraft (Dean, 1957). In addition, the smooth-flowing river reaches and the network of lakes possessed admirable attributes for the use of aircraft: in summer they provided ready-to-use landing strips for pontoon-equipped aircraft, and, after freeze-up, the frozen surfaces made excellent landing fields for ski-equipped aircraft. The most remote areas of the region had become accessible by air.

Most settlements today have air service throughout the year thanks to the development of modern radio-navigation aids. The location of airports and the names of their operators are shown on Map 22.

Many types of aircraft were used; most were convertible from pontoons to skis or wheels depending on the type of terminal and on the season. Of the 42 airports in the study area, about three-quarters (33) were based on water; most were equipped with radio beacons for the guidance of aircraft. Those centres which were only water terminals were restricted for several weeks each year during break-up and freeze-up. The short summer season afforded the greatest activity. Ice landing strips were widely used; the ice on lakes and rivers usually makes a safe landing surface by late December or even earlier. The increasing use of larger aircraft have brought about improved land-terminal facilities.

Timmins was the only centre receiving scheduled air service by a Class I airline. Among the more remote points, the most important are connected by regular-point service. The main centres of this type of operation were Red Lake, Central Patricia and Moosonee. Many other points are served by irregular non-scheduled service and charter flights. In the Lowland, the scarcity of large lakes and the shallowness of others precluded the extensive use of float planes; there helicopters have provided the best means of transport.

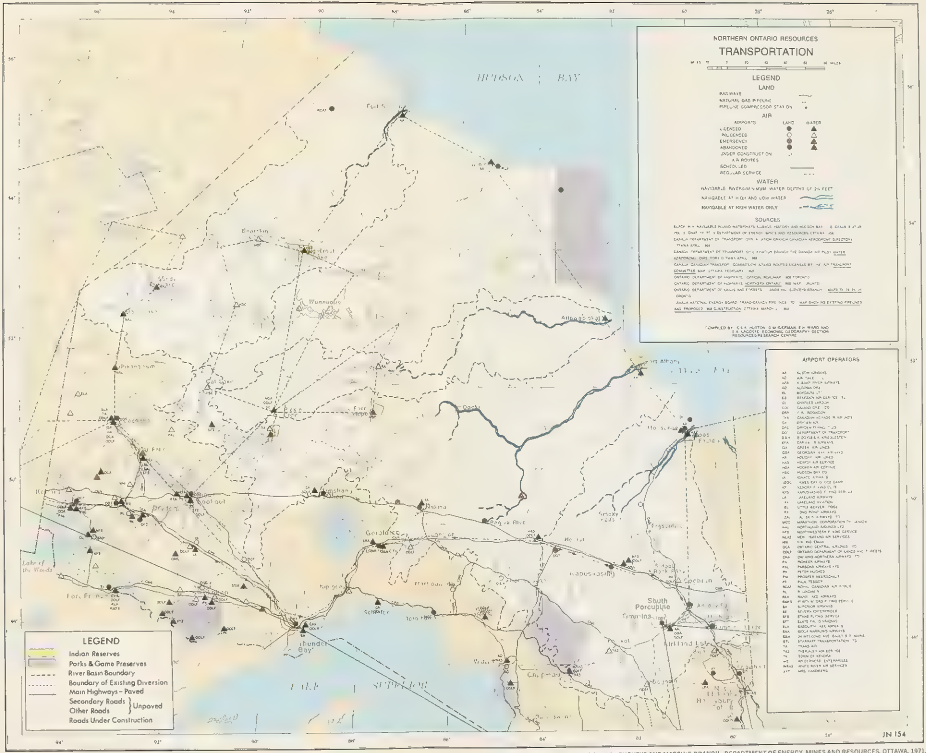
Radio communications were the most recent development to provide contact between the communities within the region and those outside the Ontario arctic watershed (Howey, 1968). The early development of radio in the region grew from the need for aids to marine navigation with the building of the railways to Churchill and Moosonee. Improved radio communications, particularly the development of high-frequency radio and high-frequency radio-telephone which permitted an aircraft to have two-way communication with a ground station during flight, accelerated the use of aircraft. Except for the southern

Moose basin, most radio stations were operated by the Department of Transport. Five coastal stations were operated by the Hudson's Bay Company; namely Fort Severn, Winisk, Attawapiskat, Fort Albany, and Moose Factory, the last being the traffic or control station for the Hudson's Bay Company in the James Bay area.

The most recent development in communications was the introduction of radio-telephone. In 1966 there were two major radio-telephone chains serving the region; specifically, Fort Severn and Winisk linked to Kenora, and Attawapiskat and Fort Albany linked to Moosonee. The second provided the terminus of the only telephone and telegraph means of wire communication in the region north of the transcontinental railway. The number of stations added to the existing chains has rapidly expanded: by 1968 a large number of isolated settlements were linked to the national telephone system (Map 23). Often a local telephone system has been installed where a location is connected by a radio-telephone link. The only television station in the region was located at Timmins; re-broadcast stations were located at Hearst, Kapuskasing and Larder Lake.

Map 23 permits a comparison between the communications facilities available in the Ontario arctic watershed and those in the southern Shield. It shows that most facilities in northern Ontario were located in communities on the railway lines and highways. In the study area they were mainly concentrated in the communities of the Clay Belt and the mining towns. The paucity of facilities across the rest of the region reflected the sparse distribution of population. Although most northern Indians reside in regions beyond commercial radio transmission (and may have little interest in it), they have access to two-way radio facilities.

Radio made the difference between isolated and non-isolated communities: with the aid of radio, aircraft could be called in to bring assistance in a case of emergency, and as need arose, to provide service or to transport goods quickly to or from the widely dispersed communities. The radio-telephone added the natural person-to-person contact in communications. Although existing services are being expanded and consolidated, it is difficult to estimate the effect of new communications technology on northern people.



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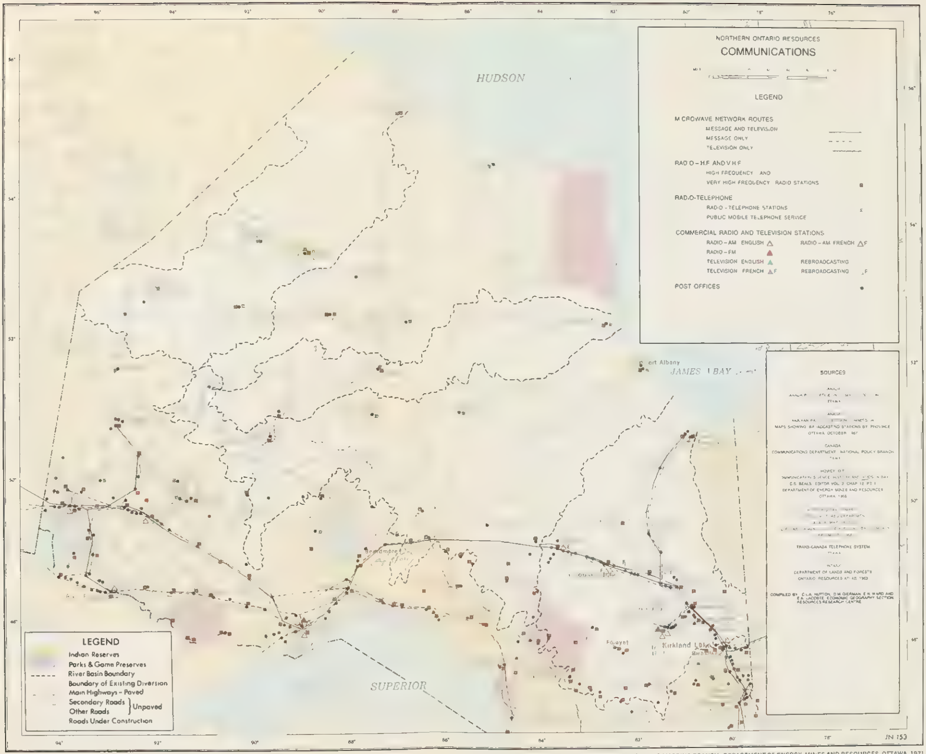

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Summary and conclusions

The natural landscape of the Ontario arctic watershed presents a wilderness environment much of which has scarcely been affected by human activities. The most northern part, the Hudson Bay Lowland, underlain by sedimentary rocks and blanketed by muskeg, marshes, ponds and stunted forest growth, conveys to the viewer a flat monotonous landscape. The southern part of the region is composed of Precambrian crystalline rocks that form the Canadian Shield. The area of the Shield, a fragmented network of rocky knobs and ridges, lakes, marshes, muskegs and the Clay Belt, is a product of Pleistocene glaciation. The rivers that traverse the ancient rocks are composed of chains of lakes, joined by short, turbulent river links. Across the Lowland, the main rivers, broad and slow-moving with low banks and marked by long straight reaches, are navigable by shallow-draft river vessels.

The forests are primarily coniferous species, such as black spruce, white spruce, balsam fir, jack pine and tamarack, with an admixture of hardwood species, particularly white birch, trembling aspen and balsam poplar. Black spruce is the dominant species of the region. Mixed stands and associations of other species depend on variations in drainage, soils, relief and climate. The Hudson Bay Lowland is dominated by sphagnum muskeg. The forest region of the Ontario arctic watershed is part of the northern boreal forest that has developed under the constraints of landforms and climate.

The population of this large area is sparse and unevenly distributed. Moose basin is the most heavily populated, and two-thirds of its population is contained in urban centres, such as Cochrane, Timmins, Porcupine and Kapuskasing. Indians constituted a small percentage of the total population; most of them lived in the Attawapiskat, Winisk, and Severn basins. Most of the non-Indian population was concentrated in the Albany and Moose basins.

The economy of the Ontario arctic watershed is strongly resource oriented. In 1967, the total value of all resources produced in the region exceeded half a billion dollars. The contributions of the various resource sectors to the regional economy are summarized below.

Mining Activity and Mineral Exploration

Until the 1960's most mineral production was associated with gold. During the 1960's, however, the mining economy developed a dramatic emphasis on base metals, particularly copper, lead and zinc. The total value of minerals produced in 1967 was about $301 million, of which base metals accounted for more than 90 per cent; moreover, almost the entire mineral production of the region was derived from the Timmins-Porcupine-Matheson mining district of the Moose basin.

In 1968, in the Timmins-Porcupine-Matheson mining district, there were six mines in operation, about one-half the number of mines in operation 5 years earlier. Texasgulf's dramatic copper-zinc-silver discovery came into production in 1967. In 1968 only one mine was operating in the Nakina-Geraldton-Longlac area; six mines had closed earlier. There were no active mines in the Attawapiskat or the Winisk basins, but in the Severn basin one mine was being prepared for production.

The Emergency Gold Mining Assistance Act (Canada, 1970), which provided financial assistance to the gold-mining industry, has had considerable impact in stabilizing communities dependent on gold mining. The proposed construction of smelting and refining facilities in the region could provide increased employment opportunities and the introduction of new skills. Moreover, the increasing demand for minerals with attendant higher prices may stimulate a search for new minerals, the utilization of low-grade reserves and the re-opening of old mines, and may provide increased employment opportunities in the region.

Forest Industries

First, with the completion of the railways, and later, with an expanding road network, the forest-based industries have steadily increased their harvesting operations in the region. By 1968, the production of wood products, second in value to mineral production, totalled $197.5 million. Most of the industries were located in the headwater areas of the Moose and Albany basins.

Most logging activities were part of larger integrated company operations, which utilized the cut for lumber,

plywood, chips, pulp and paper. Spruce and jack pine constituted 90 per cent of the total cut; the rest consisted mainly of white birch, poplar, balsam fir and tamarack. The forest resources of the Severn, Winisk, Attawapiskat and middle Albany basins were scarcely used. The amount of mature standing timber suitable for sawlog material in these basins was about 15 per cent compared with 35 per cent for the Moose basin; the remaining 85 and 65 per cent respectively were suitable for pulpwood.

As forests are a renewable resource, wood operations have tended to provide greater stability for communities than mining operations. In recent years a growing world-wide shortage of wood products has stimulated demand and has resulted in higher prices and greater employment opportunities in the industry.

Mechanization has tended to make fuller use of raw materials and to reduce the number of men required by the industry. The trend towards integration of operations has resulted in a more select use of timber: for example, logs suitable for lumber are transported to sawmills rather than being shipped to the pulp and paper mills. Since wood chips are now made from pulpwood that is not transported by water or lying in booming ponds, the quality of newsprint has improved.

Any expansion of the industry can be expected to increase the present proportion of allowable cut through the building of bush roads into presently inaccessible forest stands.

Fur Trapping

Fur trapping is the oldest extractive resource in the region. Furs were sought by the French traders, by the North West Company traders of Montreal and by the Hudson's Bay Company. Throughout much of this early period, the supply of raw furs depended on the Indian trapper.

In the late 1960's the average annual value of wild furs produced in the region was about $1.1 million. The catch varied greatly from basin to basin. The most productive area was the Albany basin; the least, the Hudson Bay Lowland. The Indian proportion of the catch was about 30 per cent; non-Indian trappers were primarily confined to the southern Moose and Albany basins.

The marten is one of the valuable furs taken in the Ontario arctic watershed.

Fur trapping is still of special importance to the Indian people. The proportion of estimated earned income derived by Indians, by basin, in 1968 varied from a low of 10 per cent to a high of 90 per cent.

Numerically, beaver and muskrat were the dominant furs harvested in the region. Beaver accounted for two-thirds of the value of pelts marketed. Other valuable furs were otter, marten and mink.

The extent of wild fur resources is difficult to assess. The abundance, distribution and life cycles of fur-bearing animals are affected by such ecological factors as forest and tundra cover, climatic conditions and food supply. Market factors also affect the catch: low demand and low prices have tended to produce a light harvest. Substantial increases in fur prices could encourage more intensive trapping and the opening of new trapping grounds.

Commercial Fishing

Because of cool waters and other contributing physical factors, the fish of northern lakes and rivers have

been particularly sought after by the sportman and have provided the basis for a commercial freshwater fishery. Pickerel and whitefish are the most important commercial species; other important species are sturgeon, pike and lake trout. The commercial fishery yielded about $451,000 annually: the upper Severn provided almost one-half of this amount; the Moose provided the least.

The main commercial fishing areas coincided with the distribution of most of the region's Indian population. Indians accounted for two-thirds of the total value of all fish landed in the 1966-68 period; most of which were taken from the Severn, Winisk, Attawapiskat and Albany basins. Only in the Albany and Moose basins did the catch of the non-Indian fishermen exceed that of the Indian fishermen.

Generally, yields of fish catches in the region have been stable; whereas market prices have not. On the whole, the commercial fishery was slightly developed. With more intensive management, processing and marketing practices, commercial fishing activities could be extended into other non-utilized but productive lakes and rivers of the region, and it is anticipated that many waters already fished could provide increased yields.

Agriculture

For about half a century, some 1¼ million acres of the Clay Belt have been opened to settlement. At the present time, only a few thousand acres can be classed as established commercial farms. A much larger area is composed of partial clearings of abandoned farms.

The farming community contributed a comparatively small proportion to the total economic activity of the region. The 1966 Census showed that the sale of farm products totalled about $1.9 million. Although the number of active farms has declined by one-quarter since 1961, the number of farms exceeding 400 acres in size has increased. About one-quarter of the farms were considered "commercial"; the other three-quarters were non-commercial, subsistence or part-time units. Over one-half of all farms were dairy operations and a further one-third were in the "other livestock" and poultry categories.

Development of intensive agriculture is hindered by the small size of local markets, by distance from large southern urban markets, and by the comparative advantages enjoyed by large farming areas adjacent to southern urban markets. These disadvantages are reflected in agricultural productivity: productivity, in terms of the sale of farm products by census farm, averaged $2,496, in contrast with $9,259 for Ontario; in this sense, the Clay Belt could scarcely be classed as a commercial-farming region.

The potential for expanded agriculture is great: estimates of arable land run as high as 16 million acres. Of this amount only 75,441 acres or about 3 per cent was improved farmland in 1966.

Recreation and Tourism

Recreation and tourism is the most recent industry to become established in the region; it is firmly based on the intrinsic values of the natural environment. The environment of the Ontario arctic watershed is relatively unspoiled by man's activities; its rivers and lakes are largely unpolluted; its forests present a primeval aspect and its Precambrian rocks impart a feeling of timelessness.

Recreational development in the Ontario arctic watershed is much less advanced than in the southern areas of the Shield; about one-fifth of the accommodation units and a similar proportion of the provincially operated camp sites in northern Ontario are located in the watershed, and mainly in the Moose basin. Many accommodation establishments, operating directly as outfitters, provided guiding services to tourists. Most "fly-in" camps, as well as many of the camps in the southern sections of the study region, employed local Indian guides – a practice which has contributed substantially to the income of many northern residents.

Provincial parks occupied 9,060 square miles in northern Ontario: the most notable is Polar Bear Park and the Winisk Wild River Park.

The Ontario arctic watershed possesses a stimulating and invigorating climate that is in sharp contrast to the uncomfortable humidity, high temperatures and smog-filled air that overhangs southern cities. The wilderness environ-

Glassy Falls on the Missinaibi River.
Credit—Geological Survey of Canada

ment is largely undeveloped: recreation, a dynamic growth industry, has become firmly established. Northern residents could benefit as recreational development progresses, particularly in a long-term sense, provided that the wilderness environment is maintained as a viable social, economic and regional asset. Many proposals have been made to set aside reaches of northern rivers as wild river parks and preserves. The recognition of wilderness as an asset is of critical importance not only for those living today but for generations to come.

Electric Power

Topographic variability has produced irregular gradients in the headwater areas of the Ontario arctic watershed that provide sites for power generation and reservoirs for storage of water. The earliest hydro-power installations were the HEPCO stations on the Mattagami River built from 1911 to 1923 to supply power to the Timmins-Porcupine gold mining area. In the 1920's further generating stations were built to supply power to the mills and company towns of APPC and SFPPC. These early stations provided power for local use and were non-integrated systems. The greatest growth in power generation came in the late 1950's and the 1960's with the development of long-distance, high-voltage transmission. By 1967 the value of electrical generation at source had grown to some $10.5 million.

In 1967-68, total annual capacity of all hydro-generating stations in the Ontario arctic watershed was 8.1 billion kWh; actual output, however, was 68 per

cent of capacity. All of the electrical power was generated in the Moose basin.

Total consumption of electrical energy in the Moose basin was 23 per cent of total output; the other 77 per cent was exported to consumers outside the watershed. HEPCO has provided an extensive and interconnecting transmission system, assuring a continuity of power from a diversity of sources.

In addition to the 14 developed power sites, there were 10 undeveloped sites in the Moose basin with a potential capacity in excess of 600,000 kW; other minor undeveloped sites exist. The only large thermal generating plant in the region is operated by SFPPC at Kapuskasing. The extensive low-grade lignite coal deposits at Onakawana could support, it is estimated, a potential on-site 1,000-megawatt thermal-electric generating station (Canadian Press, 1974). Most sites have provision for the installation of additional generating units. Mining and forest industries will remain the primary users. As the transmission network is expanded, local diesel generating units operating in isolated communities are likely to be phased out.

Transportation and Communications

The rivers, which discharge into James and Hudson bays, were the main carriers until the coming of the railways.

The CPR line was completed in 1884-85, the Canadian Northern in 1911, and the National Transcontinental (CNR) in 1913. The completion of the Algoma Central in 1913 and the Ontario Northland in 1932 followed. It was mainly the National Transcontinental, built through the Clay Belt and the headwaters of the Abitibi and Albany rivers, that brought the most profound changes. It brought an end to the fur brigades; agricultural settlers moved in to occupy the Clay Belt; pulp and paper companies and sawmilling outfits became established at locations where the railways crossed major rivers; the Indian people moved into settlements along the railway right-of-way and Indian culture came into contact with white culture on a vast scale. The railways changed the economy of the region: the fur economy, dominant for almost three centuries, was overwhelmed by the extractive-resource economy of the 20th century.

The first dirt or wagon roads were built to provide access to mines, to lumber camps and to agricultural settlements in the Clay Belt. Improved gravel roads followed. More recently the building of an all-weather, paved highway network has extended the range of accessibility that was provided by the railways. The Trans-Canada highway is the longest all-paved highway in the Ontario arctic watershed. There were also several thousand miles of bush and winter roads, mostly in the southeastern corner of the region.

Air service has provided an expanding role that began in the 1920's. Most settlements have air service throughout the year and most types of aircraft are used. Timmins is the only centre in the region with scheduled air service by a Class I airline. Among the more remote points, the most important are connected by regular service; many other points are served by irregular non-scheduled service and charter flights.

Radio communications followed aircraft in providing contact between the communities within the region and outside points. Radio-telephone was the most recent development in communications; it has added the natural person-to-person contact in communications and has removed the most glaring aspects of isolation. By 1968 a large number of isolated communities were linked to the national telephone system. Most communication facilities are concentrated in the communities of the Clay Belt and the mining towns.

It is difficult to estimate the long-term effects of the new radio-telephone technology in communications on northern people. The extension of the road network is easier to assess. It can be expected that the road network in the eastern part of the watershed will be extended and that communities in the western section will be connected to the Trans-Canada Highway. The expanding road network, providing access to new forest, mineral and recreational resources, will gradually draw this extensive region into the modern economy as effectively as when the National Transcontinental was driven through the Clay Belt over 50 years ago.

Ontario Northland excursion train.

Water Use

The economic activities of the region depend directly on water in varying degrees: the mining industry accounted for about three-quarters and the pulp and paper industry for about one-quarter of the total man-made demand for water. An insignificant amount is required for domestic and municipal use. In mining, most water is used in the processing of ores. Increased mining processing, and pulp and paper production—using the wet process—will inevitably increase water requirements: about 250 tons of water are required to produce a ton of sulphate wood pulp (Morris, 1968). Rivers have served as the primary carriers of logs and may do so for some time to come despite the well-established trend toward increased transport by truck. In addition, almost the entire electrical power production for industrial use and over three-quarters of export power is generated at sites in the region: hydro-electric power is the main source of energy used by the region's industries.

Water provides indirectly important non-commercial functions in other sectors of the economy. Of the leading fur-bearing animals—beaver, muskrat, otter, mink and marten—the first three, the dwellers of ponds, streams and marshes, accounted for 81 per cent by value of the fur catch of the region. If mink, a shore and stream hunter is included, the marketed value of water-oriented furs rises to 90 per cent. The harvesting of freshwater fish species provided the basis for the commercial fishery of the region. Much of the recreation sought by the tourist is water-oriented; clean, unpolluted water is basic to the summer

camper and cottager, to boating and sports fishing, to the autumn duck and goose hunter, and to guiding and outfitting activities. Water is also basic to efficient air transport service in both winter and summer.

Water, in association with other factors, affects Clay Belt agriculture. Because of excess water, soil drainage is generally poor, and summer weather generally too cloudy and wet for the dependable ripening of grain crops. The excess of precipitation over evapotranspiration and the resultant standing water is a major factor in the propagation of the water-logged sphagnum environment of the Hudson Bay Lowland.

Environmental Concern

In recent years informed individuals, private groups and governmental agencies have been concerned about the visibly deteriorating environment and the effects of human activities on ecological systems (Black, 1973). There is deep concern about northern environments where nature has imposed severe constraints on ecological systems that are considered particularly sensitive to present-day industrial activities. Environmental consequences of resource extraction and processing are not always clear: basically, economic benefits have tended to be more apparent than environmental consequences and, moreover, trends in resource development have been much easier to trace than ecological deterioration.

Most attention has been focused on the mining and forest industries. Changes are being considered, such as the reduction of the toxic content of the effluent or the recycling of industrial water. The recycling of water in the production of a ton of steel has shown, for example, that the amount of water required can be reduced from about 50,000 gallons to about 1,400 gallons (Morris, 1968). The magnefite process used in paper making has reduced the toxic content of effluents, as chemicals are reclaimed. It has been difficult to determine environmental consequences of large-scale expansion in the two industries due to a comparative lack of research in northern regions. Little was known of the extent of pollutants in the river and lake systems either from industry or from municipal sources, or about the effects of the effluent on freshwater biota, flora and wildlife in the region.

Fires, often caused by human carelessness, have taken a drastic toll of forest resources and have contributed to unsightly landscapes: in the severe forest-fire year of 1961 over 1,130,000 acres of forest land were burned over in the Ontario arctic watershed.* Agricultural practices (Hills, 1960) have degraded both good and poor lands alike; it is estimated that 1,500,000 acres of the Clay Belt have been misused by man, reducing the potential forest and agricultural resources of the region.

Commercial fishing, fur trapping, recreation and tourism are perhaps the most vulnerable resources subject to environmental degradation, as all are dependent to a large degree on a natural environment. Beaver, muskrat, duck, geese and trout are some of the wildlife species that are dependent on clean, unpolluted water. Fishing and trapping were two activities that were especially important in the economy of the Indian people. Recreational growth has been increasing at an accelerating rate and is likely to continue, provided that the wilderness environment is maintained not only as a viable social and economic asset, but also as an ecological entity.

Although the past history of resource extraction in this country has been marked by ruthless exploitation, the growth in recent years of public opinion affecting sensitive resources speaks well for the future. Continuing trends in water recycling and effluent treatment are indeed noteworthy, particularly since the economic prospects of the region are promising.

Theoretical Summary

Frequent contrasts have been made, particularly in the maps, between the Ontario arctic watershed and the adjacent northern Ontario hinterland. Regional contrasts usually provide grounds for the staple-export theory of growth in which exports depend on a region's endowments and market accessibility. In the past, Canada supplied important staples to European markets: fish and furs were the earliest, forest products were added in the 19th century, and wheat by the end of the century. In the Ontario arctic watershed, furs have continued to be an important staple, but in this century mineral concentrates,

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*Personal communication – W. L. Sleeman, Director, Forest Fire Control Branch, Ministry of Natural Resources, Toronto, Ontario.

forest products and hydro power were added; all of which were destined for either national or international markets outside the region.

Continued growth in the Ontario arctic watershed depends not only on resource endowment and market accessibility, but also on attainment of threshold population for the internal production and consumption of a wide range of goods and service.* Secondary manufacturing and service activity have tended to gravitate toward the southern Ontario urbanized region, thereby leaving hinterland areas dependent on primary industries geared to extractive resources. Although some forces tend to sharpen the disparities between the hinterland and the heartland, others tend to reduce them (Ray, 1971). The latter include: the spread effects of growing markets and improving technology that can benefit localities in the hinterland; the protection afforded hinterland industry by distance from the heartland; the increasing congestion of both the Canadian urban heartland and the adjacent American heartland and special amenities which parts of the Ontario hinterland have to offer.

Socio-economic problems affecting the welfare of individuals in the Ontario arctic watershed are similar to those of the much broader Canadian hinterland. When compared with the prosperous industrial heartland regions, wide differences emphasize the irregularities in regional components, such as income, education, housing, employment opportunities and many others. The development of the region's potential resources can only bring about greater amenities and community viability in the Ontario arctic watershed.

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*The Ontario arctic watershed is part of Designated Regions under the Regional Development Incentives Act 1969. Under the Corridor Area designation, Moosonee is considered a possible major growth centre; Noranda (or alternatively Timmins) is indicated as a second important centre.

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